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# AN INVESTIGATION OF EFFECTS OF AUDITORY AND SOCIAL ISOLATION ON LISTENING COMPREHENSION

by

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled *An Investigation of Effects of Auditory and Social Isolation on Listening Comprehension* submitted by Earl Russell Misanchuk in partial fulfilment of the requirements for the degree of Master of Education.

# ABSTRACT

The purpose of this study was to investigate effects of auditory and social isolation on listening comprehension as measured by a listening test. A total of 144 fourth-, fifth-, and sixth-grade students were stratified according to grade level and randomly assigned to six physical environments (no auditory isolation in an individual carrel; auditory isolation in an individual carrel; no auditory isolation in a small group; auditory isolation in a small group; no auditory isolation in a class-size group; auditory isolation in a class-size group) and were subjected to a modified form of the *Lewis Listening Test*.

The scores achieved by the students were subjected to a two-way analysis of variance to determine: (a) whether the two levels of auditory isolation affected the scores achieved, (b) whether the three levels of social isolation affected the scores achieved, and (c) whether the interaction of auditory and social isolation affected the scores achieved.

Examination of the data led to the formulation of an *a posteriori* hypothesis (subsequently tested by means of a *t* test) concerning the equality of scores achieved by students tested in individual (carrel) environments and students tested in group environments.

The findings of the study indicated that neither

the two levels of auditory isolation nor the three levels of social isolation had a significant effect on the test scores ($\alpha = .05$). Interaction effects were likewise not significant. The students tested in a group environment performed significantly better than students tested in an individual (carrel) environment ($\alpha = .05$). The latter findings were interpreted with qualifications since the study did not originally intend to investigate the equality of test scores achieved by students tested in group environments and students tested in individual (carrel) environments.

The conclusions were that: (a) auditory isolation within the three degrees of social isolation investigated did not significantly affect the scores obtained on the test used; (b) none of the three levels of social isolation investigated produced a significant effect on the test scores obtained within the two levels of auditory isolation investigated; (c) no particular combination of levels of auditory and social isolation produced test scores higher than any other combination; and (d) there is some indication that students tested in group environments achieve higher on the listening test than students tested in individual (carrel) environments, but replication is necessary before further conclusions can be drawn.

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# CHAPTER I

# INTRODUCTION TO THE STUDY

## Background to the Problem

### *Research in Listening: Historical Perspectives*

Listening as a form of input communication is as old as man himself. It preceded reading by an inestimable period of human development, and was one of the dominant means of learning from others until a few centuries ago.

Yet, for a long time, listening was largely ignored by researchers as an area of inquiry. "It was taken for granted that listening ability was something that anyone with normal hearing possessed (Duker, 1963(a), p. 136)." The relatively recent input communication mode of reading can boast research studies numbering in the thousands, while the area of listening has had comparatively few investigations (Spearritt, 1962, p. 2).

Serious investigation into listening behavior is less than 20 years old, with 90% of the research in the field having been conducted since 1952 (Taylor, 1964, p. 3).

### *The Importance of Listening*

Rankin, in a classic study (Rankin, 1926), found that 68 adults spent 70% of their total waking day

engaged in communication of one kind or another. Of that communication time, 42% was spent in listening, 32% in speaking, 15% in reading, and 11% in writing. The actual percentages probably have little validity today, but one could speculate that since the widespread dissemination of radio and television, an even greater proportion of the waking day is spent in listening.

Other studies, more pertinent to the educational situation, have been done. One, employing female college students as subjects (Bird, 1953), found that 42% of their communication time was spent in listening, 25% in speaking, 15% in reading, and 18% in writing. Another study found that 530 children in grades one through eight spent 57 1/2% of their classroom time listening (Wilt, 1950). "Recently, researchers have estimated that close to 90 percent of the class time in high schools and colleges are spent in listening to discussions and lectures (Taylor, 1964, p. 3)."

*Degree of Comprehension in Listening*

Although listening appears to be a common learning mode, some research shows that most listeners comprehend and retain a relatively small amount of the oral material they hear:

> In one experiment in which selections were read to fourth-grade children and comprehension checks followed, only 21 percent to 33 percent of the content was retained. Almost daily,

> one faces situations in which people half hear, ask for repetition of what was said, or are unable to follow verbal directions competently and accurately (Taylor, 1964, p. 4).

Cartier (1955), while investigating "listenability" and "human interest", recorded passages of 300 words at three levels of "human interest" and seven levels of difficulty, and presented the recorded passages to tenth-grade students. The comprehension of each passage was evaluated by 15 multiple-choice questions. One of the conclusions drawn was that:

> The comprehension scores were considered to be quite low. One half of the subjects obtained scores indicating that they comprehended only about half of what they heard, while a fourth of the subjects were apparently incapable of comprehending more than a third of the material. Only a fourth of the subjects appeared to comprehend as much as two-thirds of the material (Cartier, 1955, p. 55).

The abovementioned research results suggest that oral instruction in the classroom is not always fully comprehended by students. It has apparently always been assumed by teachers that so long as a student can hear, he will comprehend and learn. This in itself is an audacious assumption, but an equally audacious assumption that is commonly made is that unless a student makes a complaint, he is hearing efficiently whatever he is supposed to be hearing.

*The Future of Listening*

Today, much thought in education is devoted to the individualization of instruction, and one concept that constantly recurs in this context is that in the future, more instruction will be presented by electromechanical or non-human 'teachers'.

> Already, computers are demonstrating their usefulness in teaching spelling, mathematics, reading, and a host of cognitive skills. Tapes, screens, records, and other audiovisual devices, coupled with the computer, make possible a unique instructional system of sight, sound, and touch (Goodlad, 1968, p. 8).

The Trump Plan espouses individual study for a high proportion of the student's time, and stresses that individual study will include not only reading, but experimenting, viewing, and listening, as well (Trump & Baynham, 1961, p. 28).

Taylor makes this observation:

> Many schools are making increased use of individual learning or study stations (carrels) which, in addition to reducing noise, have the additional benefits of reducing visual distraction and providing better illumination (Taylor, 1964, p. 20).

A relationship can be drawn between the contents of Taylor's statement and the Trump Plan: students will be doing the majority of their individual study in some form of carrel. Many of these carrels may accomodate some kind of electromechanical 'teacher'.

It is possible, therefore, to assume that much instruction will, in the future, come from materials which present prerecorded oral instruction or combinations of oral and visual messages. Accepting this assumption, one could hypothesize that listening as a learning mode will at least retain its current importance.

## Definition of Terms

The terms *Listening Test* and *criterion measure* refer to a modification of Form A of the standardized test of listening comprehension developed by Lewis (1954). A transcript of the Listening Test is in Appendix B. Appendix C lists the modifications made to the original Form A of the *Lewis Listening Test*.

*Auditory isolation* refers to the elimination of ambient noise by means of headphones connected to a tape recorder through the use of one or more listening centers or patch cords.

*Social isolation* refers to the restriction of the social environment as reflected by group size. This study refers to three levels of social isolation: (a) a *class-size group* is a group of 24 students in a conventional seating arrangement in a classroom, (b) a *small group* is a group of six students seated in a roughly circular arrangement in a small seminar room, and (c) an *individual*, when spoken of in terms of social isolation, is one

student in a carrel.

*Listening comprehension* is the ability to understand oral material. In this study, the oral material was recorded on audio tape. Listening comprehension can be thought of as including: (a) getting the main idea from an oral selection, (b) recalling facts and details, (c) making inferences from the facts presented in an oral selection, (d) recognizing word meanings from context, and (e) being able to follow oral instructions. These factors were considered to be the most important ones by Lewis (1954), and hence the ones he set out to test. A more complete discussion of the test objectives of the *Lewis Listening Test*, and therefore, the Listening Test used in this study, is given in Chapter III.

A *listening center* is a multi-outlet junction box to which headphones are connected. The listening center is connected to a sound source such as a tape recorder, record player, or film projector.

## The Problem

As is evidenced by the Review of Related Research (Chapter II), a few variables which influence the degree to which oral material is comprehended have been identified. Among these variables are listening instruction, rate of presentation, and age and grade level of the listener.

These represent only a few of the possible factors that could conceivably be related to listening comprehension, and investigation into other areas would be desirable.

An area that appears to have been ignored by previous research is that of the physical environment of the listener. One resumé of the research in listening discusses only hearing deficiences, classroom noise level, and the existence of carrels as described earlier (Taylor, 1964, p. 20). The discussion is neither extensive nor explicit, and appears to be subjective, with no obvious basis in research. It would seem, therefore, that the physical environment of a listener could profitably be investigated, with the aim of identifying, and perhaps quantifying, effects of certain variables within the listening environment.

Several classroom teachers have mentioned to the investigator that auditory isolation appears to affect listening comprehension. The teachers have observed, through subjective appraisal, that when students use listening centers, their immediate comprehension appears to increase (especially at the upper-elementary and junior-high school levels). In other words, a student in auditory isolation (using a set of headphones connected to a listening center) appears to comprehend oral material better than when he does not use headphones.

There are several possible explanations for the allegedly-observed phenomenon, such as: (a) auditory isolation tends to focus the attention of the student, (b) auditory isolation masks out distracting ambient noise, and (c) the novelty of auditory isolation causes the student to pay more attention to the material being presented.

The three possible explanations listed above add up to form a 'common-sense' kind of explanation for the alleged increase in listening comprehension. However, there appears to be no research available which either substantiates or refutes the idea that an increase in listening comprehension does occur as a result of auditory isolation. One of the purposes of this study was to investigate effects of auditory isolation upon listening comprehension.

Students of group dynamics and interpersonal interactions are aware that a person may behave differently as an isolated individual and as a member of a group. Observation of students working in a group situation as contrasted with students working in individual carrels tends to confirm the supposition that differing degrees of social isolation affect attention and concentration.

The possible distractions afforded by a small group situation may have a negative effect on listening compre-

hension . Conversely, isolation, or lack of opportunity for interpersonal interaction, such as that afforded by carrels, may have a positive effect on listening comprehension.

On the other hand, isolation of a student from his peers may work to interfere with listening comprehension by removing some unknown factor.

It was also a purpose of this study to investigate effects of social isolation on listening comprehension.

## Purpose of the Study

The purpose of this study was to investigate the following questions:

(a) Does auditory isolation via headphones, under certain degrees of social isolation, affect listening comprehension as measured by a standardized listening comprehension test?

(b) Does the social environment of the listener, under certain degrees of auditory isolation, affect listening comprehension as measured by a standardized listening comprehension test?

(c) Do the degree of auditory isolation of the listener and the degree of social isolation of the listener interact in such a way as to affect listening comprehension as measured by a

standardized listening comprehension test?

## Overview of the Experiment

The experimental design, a posttest only 2 × 3 factorial design, was chosen because of its expedience in providing answers to the questions posed without sacrificing rigor. Students were randomly assigned to three categories of social isolation (individual, small group, and class-size group) concomitant with two categories of auditory isolation (wearing headphones and not wearing headphones). While in these situations, they were subjected to a listening test recorded on audio tape. The results of the tests were analyzed to determine the existence of effects of auditory isolation, social isolation, and interaction between the two.

## Need for the Study

Researchers in audiovisual education state that more information is needed regarding the influence of specific factors in the design characteristics of the media (Lumsdaine, 1963, p. 601). In the past, researchers in audiovisual education have often been concerned with questioning whether or not a particular medium or group of media can, in fact, teach. Today, with rapid technological advances in education being a characteristic of the times, the question

most frequently asked concerns how a medium or group of media can be used most effectively. For example, Schramm (1968) calls for research into where and how television may be used most effectively. The same plea could be made in areas involving other media. In view of the trends described earlier under *The Future of Listening*, it would seem desirable to know the influence of the physical environment on listening comprehension.

Research has been done toward defining the psychological conditions of learning, but the area of physical conditions of learning has been largely ignored. As already mentioned, Taylor (1964) provides little specific information on the optimal conditions for effective listening. The recommendations of other experts writing about classroom listening are equally meagre (Brown, Lewis, & Harcleroad, 1959; Dale, 1954; Wittich & Schuller, 1967).

The only study located that attempted to measure one of the variables that make up the physical environment of the listener (Lindsey, 1953), investigated the effects of interruptions on listening comprehension. Lindsey provided three kinds of interruptions while reading stories to his intermediate-grade class: (a) music over the school public-address system, (b) two announcements over the public-address system, and (c) pupils entering and leaving the classroom. The results indicated

that the interruptions had less effect on listening comprehension than did the interest level of the material presented.

If one particular listening environment could be identified as being measurably superior to another, a basis for decision-making would be obtained. A teacher could, on the basis of research, be able to decide whether or not control of the listening environment is justified in terms of student gains in comprehension.

Some schools have already incorporated small-group meeting rooms and student carrels into their physical plants, while others are considering doing so. The decisions to provide these kinds of student stations appear to be based on the logical arguments provided by proponents of cooperative or team-teaching. This study could provide information about the value of seminar rooms and carrels with respect to listening comprehension of recorded oral materials.

## Limitations of the Study

This study used as subjects only students at the fourth- to sixth-grade level in one Edmonton Separate School. The results of the study, strictly speaking, apply only to the children involved in the investigation. Extrapolations to other fourth-, fifth-, and sixth-grade

students in other schools may be ventured only if the populations are similar to the one that participated in the experiment.

The investigation was restricted to effects of auditory and social isolation on listening comprehension as measured by a standardized listening test. The definitions of auditory and social isolation as used in this study have been provided earlier in the section Definition of Terms.

No attempt was made to assess the validity of the listening comprehension test used. Justification for assuming the validity of the Listening Test is elaborated on in Chapter III. Suffice it to say here that it was assumed that the score achieved on the Listening Test was a valid measure of the listening comprehension of a student.

The level of motivation in the experimental situation was likely higher than normal since the students were aware that they were in a testing situation. Thus extrapolation of the results of this study to non-testing situations must be done with caution.

## Assumptions

This study assumed that: (a) individuals differ in their ability to comprehend oral instruction, (b) listening ability, like other human abilities, is distributed

normally among the general population in accordance with the principle of normal probability, and (c) the score achieved on the Listening Test is a valid measure of the listening comprehension of a student.

## Overview of the Remainder of the Thesis

Chapter II reviews some of the research relevant to this study. The statistical design, the sample, materials and equipment used, and the experimental procedure are recounted in Chapter III. Chapter IV deals with the findings of the study and their statistical analyses, while the conclusions and a discussion of the implications of the study are treated in Chapter V. The appendices hold a transcript of the orientation tape and the Listening Test tape, with related materials, and a description of the sample school and students. Item analysis results are also located in the appendices.

# CHAPTER II

## REVIEW OF RELATED LITERATURE

Although no studies on the effects of auditory and social isolation on listening comprehension could be located, some of the literature relevant to this study is reviewed in this chapter. The areas of research considered include the grade level investigated, the effects of listening instruction, presentation rates, sex superiority, live versus recorded speakers, student hearing difficulties, increase in listening comprehension with age and grade level, availability of listening tests, defensibility of listening tests, and administration of listening tests.

### Grade Level Investigated

Taylor (1964) states that listening is a more important communication mode than is reading for most elementary-school children. He comes to this conclusion by comparing (a) the average word recognition time while listening with the average word recognition time while reading, and (b) the average rate of reading with the average rate of speaking (and, therefore, listening). In both cases, convergence of rates occurs at about the sixth-grade level. Taylor also states that listening is preferred to reading, when a choice is given to elementary-

school children, and listening is preferred by sixth- and seventh-grade students when the content is judged 'easy', but reading is preferred when the content is judged 'difficult'.

As previously mentioned, Wilt's study (Wilt, 1950) indicated that over half of an elementary-school student's time is spent in listening. Wilt studied nineteen 'typical' classrooms, ranging in level from the first grade to the eighth, for one day each, and found that the children spent a median time of 158 minutes per day engaged in listening. This figure represented 57 1/2% of their school day.

While Wilt's one day of observation per classroom hardly provides a definitive statement about the amount of time spent in classroom listening, it does give some indication of the degree to which elementary-school children must depend on listening.

The original impetus to conduct the present study at the upper-elementary school level came from the teacher comments discussed in Chapter I. However, the arguments of Taylor and the results of Wilt's study described above tended to strengthen the indications that this study could profitably be conducted at the fourth- to sixth-grade level.

## Effects of Listening Instruction

There is evidence that certain kinds of listening instruction aid in increasing listening comprehension. Spearritt (1962) quotes five studies relating to instruction of listening at the college level: Bird, 1953; Brown, 1954; Erickson, 1954; Irvin, 1954; and Nichols, 1949. He describes the results thus:

> Experimental groups of college freshmen who have received systematic training in listening have in almost all cases obtained significantly higher scores on listening comprehension tests than control groups who have not received such training (Spearritt, 1962, p. 5).

More recently, Whitfield (1964), working with 130 students in a basic college speech class, provided a series of listening drills to an experimental group while offering only the listening instruction contained in the regular speech course to a control group. The *Brown-Carlsen Listening Comprehension Test* was the criterion measure employed, and *t* tests showed that the difference between the groups was significant at the .10 level of confidence but not at the .05 level.

DeSousa (1967) worked with three groups of seventh-grade pupils: (a) a group which received listening instruction, (b) a group which received literature study, and (c) a control group. The listening instruction group received daily skill-development lessons over a four-week

period. The lessons centered around the areas of recognizing significant details, identifying main ideas, and following directions. The literature study group worked on a unit of literature containing stories, poems, and articles. The material was read silently by the students, and vocabulary and pertinent questions were discussed. The control group continued to follow the program of studies of the junior high school in their assigned classes. Although pre-tests of listening comprehension had shown that the groups were essentially equivalent, a parallel form of the test administered after the treatment showed that the listening instruction and literature study groups scored significantly higher on the final listening comprehension test than did the control group. The difference between the two experimental groups on the criterion measure was not significant. The fact that the literature study group and the listening instruction group were essentially equivalent in terms of the posttest suggests the possibility that an 'experimenter effect' was in operation in DeSousa's experiment. If this is true, one could not attribute the observed increases in listening comprehension to the kind of listening instruction given.

There is also research to indicate that listening can be taught at the intermediate-grade level. Fawcett (1963) provided 25 minutes of listening instruction, three

days per week for 14 weeks, to 12 classes, and, using the *Sequential Tests of Educational Progress (STEP): Listening Test*, found a significant improvement in listening for those who received instruction.

Pratt (1956), using 20 classrooms in each of the experimental and control groups, provided the experimental group with five listening lessons taught by the regular classroom teacher. The lessons were presented once per week. Alternate forms of a specially-prepared listening test were used as pre- and posttests; the experimental group scores on the posttest were significantly higher at the .01 level of confidence.

Partially-sighted students in grades four through nine were the subjects of a study by Bischoff (1967). Using two experimental and one control group, Bischoff found no significant differences between the two experimental groups that had received listening instruction, but he did find the differences between the experimental groups and the control group to be significant. An interesting aspect of Bischoff's study is that because his subjects were partially-sighted, he had to use a modified form of the *STEP: Listening Test*: the answer sheets had to be modified to eliminate reading. By making this modification, Bischoff probably increased the validity of the test, making the test more like a true listening situation,

with no reading involved.

Hollow (1955) worked with approximately 300 fifth-grade students in eight schools in each of the experimental and control groups, and ". . .established conclusively that, as a result of the planned program, there was a real difference in listening performance in favor of the experimental group (Hollow, 1955, p. 160)." Her treatment consisted of having the regular classroom teacher do the instructing, after having been provided with 30 pre-planned twenty-minute lessons. Hollow's study might be open to question on the grounds that it appears to have employed student pairs, matched on the basis of initial listening ability, intelligence, and chronological age. The description provided does not adequately establish the defensibility of the pairing procedure used.

Apparently, all the studies cited above were concerned with immediate recall as a measure of listening comprehension, rather than delayed recall. Therefore the results of the above-mentioned studies should be interpreted in that light.

As could be expected, the various programs of listening instruction provided a variety of gains in listening skills; however, all the listening instruction programs referred to above did produce significant gains in listening comprehension.

Not all listening instruction programs, however, actually do increase listening comprehension significantly. Hollingsworth, in two separate studies (Hollingsworth, 1963, 1965), compared the effects of two different commercially-available listening improvement programs. In neither study were there significant differences between the listening comprehension of pupils who had experienced the programs, and the control students who had not.

## Contingencies Affecting Listening Comprehension

### *Presentation Rates*

Seven passages of varying difficulty levels were each recorded at speeds of 125, 150, 175, and 200 words per minute (WPM) and were presented to 487 tenth-grade students (Goodman-Malamuth, 1957). Generally speaking, the emergent conclusions were that: (a)"listenability" is adversely affected by rates that are either too fast or too slow, and (b) 150 WPM appears to be the optimal presentation rate, but the range 145-160 WPM would be satisfactory.

Harwood (1955), working with the same sample as Goodman-Malamuth (and, it appears, the same seven recorded passages), found that "listenability" decreased with increased rate of presentation but the mean "listenability" at each of the four presentation rates did not differ

significantly at the .05 level from that at any other rate.

Four equivalent forms of the *Iowa Silent Reading Test* were used by Fergen (1954) in an attempt to assess the importance of rate of presentation of oral material. The different forms of the test were recorded at speeds of 80, 130, 180, and 230 WPM. After subjecting 438 fourth-, fifth-, and sixth-grade students to the experimental procedure, she concluded that listening comprehension increased as the rate increased from 80 WPM to 130 WPM, and declined as the rate increased to 180 WPM and 230 WPM. In fact, 80 WPM provided for more comprehension than did either 180 WPM or 230 WPM. However, of the four rates studied, the rate which yielded maximum listening comprehension was 130 WPM.

Taylor (1964) admits that large variations and some contradictions exist in the results of rate studies. He speculates that:

> Considering that the average listener is exposed daily to speaking rates ranging from 135 to 175 words per minute, it appears that the listening mechanism readily adjusts to variations of input, especially when the content is at or below the academic level of the listener. . . .In general, most of the studies showed that the listener preferred a speaking rate between 150 and 175 words per minute (Taylor, 1964, p. 12).

The first few words of Taylor's statement have important implications: the rate of presentation at which efficient listening occurs may be a function of familiarity. Students accustomed to hearing oral

material presented at the rate of, say, 150 WPM cannot be expected to readily comprehend material presented at 300 WPM. This would be equivalent to expecting a student who normally reads at 350 WPM to comprehend written material presented at a rate of 700 WPM.

Unless studies of presentation rate take into account the factors mentioned above, they are of questionable value.

*Sex Superiority*

Seven studies (Caffrey, 1955; Dow, 1953; Hampleman, 1955; Hollow, 1955; Irvin, 1954; King, 1959; and Nichols, 1948) have been reported as showing that males display superior performance on listening comprehension tests at all grade levels, although the difference between mean scores for males and females have not always been significant (Spearritt, 1962, p. 7). Caffrey showed that the score discrepancy between the sexes could not be attributed to differences in chronological or mental age, or to sex bias in item content.

There are studies, however, that have shown no significant differences between the listening comprehension abilities of boys and girls at the intermediate-grade level (Fawcett, 1963; Legge, 1967).

The present study, in an attempt to avoid possible

effects due to sex superiority, used a randomized design.

*Live Versus Recorded Speakers*

The findings of studies relating to the differences in listening comprehension when listening to a live speaker and when listening to an electromechanical reproduction of the speaker's voice, are contradictory. Caffrey (1955) found that a live speaker was more effective than a tape recording. On the other hand, what has been called a "well-designed experiment" by Spearritt has shown no significant difference in the listening comprehension of college students listening to a teacher in person, listening to the same presentation on television, and listening to the same presentation via an audio-only communication system (Stodola & Coffman, 1959, cited by Spearritt, 1962).

The question of relative efficiency of human and non-human presentation of oral material is irrelevant to the present study since the purpose of the present study was to investigate comprehension of recorded instruction.

*Student Hearing Difficulties*

Listening comprehension does not appear to be highly related to auditory acuity. Caffrey (1955) found that high-school students with " . . . a known hearing loss . . ." did at least as well on a listening comprehension test as

students with no hearing disabilities (Caffrey, 1955, p. 305). Nichols' findings were similar at the college level: six students with 'appreciable' [his word] hearing loss scored somewhat above the mean on a listening comprehension test (Nichols, 1948, p. 159).

Since the majority of researchers " . . . do not consider a [hearing] loss serious until it exceeds 15 or 20 d.b.'s (Taylor, 1964, p. 7)", it was assumed that children suffering severe hearing losses had been previously identified, and therefore were not a part of the research sample. In any event, the design of this study controlled for possible confounding due to hearing loss, since assignment to treatments was random.

*Increase of Listening Comprehension With Age and Grade Level*

Generally speaking, listening comprehension, as reflected by listening test scores, has been found to improve with increasing age and grade level (Caffrey, 1955; Hampleman, 1955; Wright, 1957). Hence, sixth-grade students could be expected to exhibit superior listening comprehension to fourth-grade students. Since the present study crossed three grade levels, this factor was controlled by the use of stratified random assignment to experimental groups (see Chapter III).

## Listening Tests

### *Availability of Listening Tests*

Duker's bibliography (Duker, 1964) refers to the following unpublished tests of listening comprehension: *California Auding Test, Goldstein Test, Hall Listening Test, Hollow Listening Test, Kramar Listening Test, Lewis Listening Test, Marten Listening Test, Nichols Minnesota Listening Test, Stephens College Listening Test,* and the *Wright Listening Test.* However, the same bibliography mentions only two published tests: the *Brown-Carlsen Listening Comprehension Test* and the *Sequential Tests of Educational Progress: Listening.*

It would appear that most of the unpublished tests were developed to measure the effects of instruction in listening. Despite the fact that they have been carefully constructed and evaluated, it is unlikely they have undergone more than one or two revisions. Still, the validity of the published tests has been questioned by some, and the unpublished tests have been suggested as alternative instruments (Russell, 1964). Russell criticizes the *STEP: Listening Test* on the basis that it is a mixed measure of both reading and listening, and cites evidence that indicates that many of the *STEP: Listening Test* questions can be answered by pupils who have not heard the oral material

presented as part of the test (Russell, 1964, p. 265).

Of the two published tests, the *Brown-Carlsen Listening Comprehension Test* and the *STEP: Listening Test*, only the latter has a form suitable for grades four through six. A comparison of the *STEP: Listening Test* with the test eventually used in this study (the *Lewis Listening Test*) showed that the *STEP: Listening Test* was twice as long as the *Lewis Listening Test*. The one and one-half hours required for the presentation of the *STEP: Listening Test* was felt to be excessive for fourth-, fifth-, and sixth-grade children; this extra length, coupled with the criticisms of the *STEP: Listening Test* cited above, led to the choice of the *Lewis Listening Test* for use in this study.

*Defensibility of Listening Tests*

Spearritt used a battery of 34 tests (including nine listening tests) in a factor analysis, and isolated a " . . . separate listening comprehension factor [which] indicates that listening comprehension tests do measure something not already measured by reading comprehension and reasoning tests . . . (Spearritt, 1962, p. 98)." The results obtained by Caffrey also imply that listening comprehension is a distinct factor that cannot be measured by reading or intelligence tests (Caffrey, 1955, p. 306). The results of Spearritt and Caffrey tend to strengthen

arguments for the validity of listening tests.

However, there is no general agreement that listening tests are valid. A comparison of the *STEP: Listening Test* and the *Brown-Carlsen Listening Comprehension Test* with the *Selective Admission Test* and *Cooperative Reading Test* showed that the listening comprehension tests correlated more highly with the other two tests than with each other (Kelley, 1965).

One writer voices these objections to listening tests:

> There is no evidence that learning to listen in a 'listening test' is in any way related to listening in everyday life. . . . Any method which relies wholly on how well a person can respond through other skills than that tested--he writes or checks something he has read--any such method is difficult to evaluate (Hackett, 1955, p. 457).

Hackett's first objection is irrelevant to the present study, which was concerned with recorded instruction, not "listening in everyday life". It can be argued that the Listening Test used in the present study is roughly equivalent to current methods of presentation of recorded instruction, since it contains passages of instruction, followed by recorded oral exercises relating to that instruction.

Hackett's second objection, that validity suffers because the student must write or check something he has read, was nullified by the modification of the test

used: the student was not required to read, but rather to listen to the questions presented.

*Administration of Listening Tests*

Of three modes of presentation of the *Brown-Carlsen Listening Comprehension Test* (live, on audio tape, and on film), it was shown that the audio tape version yielded the highest estimate of reliability and the film version the lowest (Johnson & Frandsen, 1963).

Caffrey (1955) found that the reliability of the *California Auding Test* was only slightly affected when the test was administered by means of a recording, and Sims and Knox (1932) showed that multiple-response items presented orally were slightly more difficult but of substantially the same reliability as written questions.

The present study modified the *Lewis Listening Test* to the extent that the multiple-choice items were presented orally. This modification likely made the test somewhat more difficult, since it placed a burden upon the students' memories. By the same token, it likely made the test more valid, since it more closely approximated a listening situation than did the unmodified test, which required reading on the part of the students. The modification also resulted in an increase in the time required for presentation.

## Summary

Despite the fact that no studies on the effects of auditory and social isolation on listening comprehension could be located, some of the literature relevant to the present study was reviewed in this chapter. The decision to investigate the fourth- to sixth-grade level, although largely determined by the teacher comments discussed in Chapter I, was reinforced by available research relating to the importance of listening in the upper-elementary and junior-high school grade levels. A review of the literature relating to effects of listening instruction showed that many programs of listening instruction developed as parts of doctoral theses had positive effects in increasing listening comprehension. However, some commercially-available listening improvement programs did not significantly increase listening comprehension. Several studies on presentation rate were reviewed, but their conclusions, that optimal presentation rates are in the neighborhood of 150 words per minute, were questioned. The possible existence of sex superiority in listening comprehension was discussed briefly. Although contradictory results have been reported with respect to the efficiency of live and recorded speakers, this factor was deemed irrelevant to the present study. Student hearing difficulties appear to have little bearing on the degree of listening compre-

hension of the student, according to the research reviewed. Listening comprehension tends to increase with increasing grade and age level, but this factor was controlled for in the present study. The titles of available listening tests were listed, and arguments for the defensibility of listening tests were given. Some evidence that recording of tests has very little deleterious effect on the reliability of the tests was presented.

# CHAPTER III

## DESIGN AND PROCEDURES

Discussed within this chapter is the design of the experiment, including a specification of the variables and the factorial design. The null hypotheses are restated, and a brief description of the sample used is provided. A description of the materials, including the Listening Test, its form, and ancillary testing materials, is presented along with a description of the equipment used. The procedures involved in carrying out the experiment are spelled out, as are the organization of experimental groups and the actual administration procedures used with the test. The chapter concludes with a brief description of the statistical procedures employed.

### Design of the Experiment

This study used the posttest only control group design (Campbell & Stanley, 1963, p. 195). Schematically, the design is:

$$R \qquad X \qquad O_1$$

$$R \qquad\qquad O_2$$

where $X$ refers to the experimental treatment, $O_1$ and $O_2$ refer to the criterion measure of the experimental and control groups, respectively, and $R$ refers to the fact

that students are randomly assigned to the experimental and control groups.

*The Dependent and Independent Variables*

The dependent variable was the score on the Listening Test. The independent variables were the degree of auditory and social isolation. The first independent variable had two levels: (a) absence of auditory isolation, and (b) auditory isolation by means of headphones. The second independent variable had three levels: (a) restriction of social environment to an individual in a carrel, (b) restriction of social environment to a small group, and (c) restriction of social environment to a class-size group.

*The Factorial Design*

The number of levels in each of the independent variables created a 2 × 3 factorial design:

| | | Degree of Social Isolation (B) | | |
|---|---|---|---|---|
| | | $b_1$ | $b_2$ | $b_3$ |
| Degree of Auditory Isolation (A) | $a_1$ | $a_1b_1$ | $a_1b_2$ | $a_1b_3$ |
| | $a_2$ | $a_2b_1$ | $a_2b_2$ | $a_2b_3$ |

where: $a_1$ refers to absence of auditory isolation,

$a_2$ refers to auditory isolation by means of headphones,

$b_1$ refers to restriction of social environment to an individual in a carrel,

$b_2$ refers to restriction of social environment to a small group,

$b_3$ refers to restriction of social environment to a class-size group.

Each cell of the design represents 24 students, assigned at random, but stratified by grade level. The cell composition is described more fully in a later section, *Organization of the Testing Situations*, while the stratified random assignment to groups is elaborated upon in *Stratified Random Assignment to Groups*, later in this chapter.

## Hypotheses Tested

The hypotheses tested, in null form, were:

Hypothesis I There is no significant difference at the .05 level between the mean scores attained on the Listening Test by students in auditory isolation and students not in auditory isolation.

Hypothesis II There is no significant difference at the .05 level among the mean scores attained on the Listening Test by students in the following levels of social isolation: (a) individual, (b) small group, and

(c) class-size group.

Hypothesis III There are no significant differences at the .05 level in the mean scores on the Listening Test produced by the interaction of auditory isolation and social isolation.

The above null hypotheses must be interpreted within the context of the factorial design described earlier. For example, Hypothesis I, dealing with auditory isolation, must be interpreted in terms of the three levels of social isolation investigated in this study.

## The Sample

The sample for the study was 144 students in a single Edmonton Separate School Board (Catholic) elementary school. This number comprised all but ten of the fourth-, fifth-, and sixth-grade students in the school. The deletion of the ten students was random.

The school was not randomly selected due to the fact that relatively few elementary schools in the system contain the student carrels necessary for the experiment.

A more detailed description of the school and students used in the study is provided in Appendix E.

## Materials and Equipment

### *The Listening Test*

The *Lewis Listening Test* was constructed to measure the following facets of listening comprehension: (a) getting the main idea from a selection, (b) recalling facts and details, (c) making inferences from the facts presented in a selection, (d) recognizing word meanings from context, and (e) being able to follow instructions (Lewis, 1954, pp. 27-34). The decision to test the above-mentioned areas was reached on the basis of a questionnaire relating to the most important facets of listening comprehension. The questionnaire was answered by a panel of 'experts' (Lewis, 1954, p. 29).

Lewis used a group of fourth-, fifth-, and sixth-grade students to subjectively validate the listening passages chosen for the test.

The content of the test is designed to cover a variety of subject areas, including biographies, elementary sociology and economics, science, social studies, and mathematics.

The *Lewis Listening Test* has two equivalent forms. In the present study, a modification of Form A was used.

Wherever possible, the *Lewis Listening Test (Form A)* was modified to eliminate possible American bias. For

example, a passage that made reference to Chicago, Illinois, was rewritten to refer to Winnipeg, Manitoba. The changes made were not major and were not likely to affect the reliability or validity of the test. The complete transcript of the Listening Test tape, including the directions given, is located in Appendix B. A detailed listing of the modifications made to the original Form A of the *Lewis Listening Test* is included in Appendix C.

A modification of the presentation procedure was made in that the multiple-choice questions were presented orally rather than on printed answer sheets. The modification was an attempt to heighten the validity of the listening comprehension test by removing the necessity for reading. This placed a burden on the student's memory, but made for a more realistic listening situation.

Each multiple-choice question was presented twice. The students were instructed to listen to all the responses on the first presentation before reacting, and to make a choice of the alternatives during or after the second reading. After the second presentation of each question, about five seconds was allowed for the students to respond. This length of time was found to be quite sufficient.

The students indicated their choices by marking the appropriate spaces on an International Business Machines answer sheet. The recorded directions for the test included

instructions on marking the answer sheet correctly.

*Form of the Test*

The Listening Test, including directions, listening passages, and multiple-choice questions, was recorded on audio tape, using professional-quality recording equipment. A professional commentator was not used; instead, the voice of a male teacher was used. The investigator recognized that the proportion of female teachers in the elementary school is higher than the proportion of male teachers, but felt that the use of a male voice would cause the Listening Test to more closely approximate commercially-available recorded materials, since the latter are usually recorded by male commentators.

The commentator used his experience as a teacher in determining the rate of presentation of the material. In other words, the nature of the material being presented was influential in determining the rate and pacing of the presentation. Subsequent timing of the various recorded selections showed that the presentation rate was roughly 150 words per minute.

*Ancillary Materials*

Student responses were recorded on International Business Machines type 5056 machine-scored answer sheets.

Since the last three questions involved reference to five digits within rectangles, a separate sheet of paper, 8 1/2" by 5 1/2", was printed with the digits, and provided to each student. This sheet is reproduced in Appendix D.

*Equipment*

The playback machine used was a Sony 530 Tapecorder. In the small group with no auditory isolation (Group $a_1b_2$), the two loud-speakers within the tape recorder were used as sound sources. In the class-size group with no auditory isolation (Group $a_1b_3$), the two extension speakers provided with the machine were used as sound sources. These two speakers were spread apart so that each speaker was in a front corner of the classroom. In the individual carrel with no auditory isolation (Group $a_1b_1$), a small speaker was placed within each carrel. These small speakers were connected to the playback machine with a multi-outlet patch cord.

In all situations involving auditory isolation, conventional inexpensive headphones, of the type commonly supplied with listening centers, were used. The headphones were connected to the tape recorder in one of two ways, depending on the group size: (a) in the small group situation (Group $a_2b_2$), the connection was through a conventional listening center junction box, and (b) in the

individual (Group $a_2b_1$) and class-size (Group $a_2b_3$) group situations, the connection was by means of multi-outlet patch cords.

## Procedures

### *Orientation of Subjects*

Before testing began, a short tape, containing information about the experiment, was played to each class involved. The purpose of the tape was: (a) to orientate the students to the research project, (b) to attempt to control possible effects of placing a student in an early-tested or late-tested group, and (c) to ask students not to discuss the test with their friends. The students apparently took the latter request very seriously; one student inquired whether it would be permissible to discuss the test with her parents!

The contents of the orientation tape are contained in Appendix A.

### *Stratified Random Assignment to Groups*

The class lists of the two register rooms for each of the three grades were combined to form grade lists. These grade lists, originally arranged alphabetically, were then rearranged into a random order, generating randomized grade lists. Since the number of students in each of the

three grades was approximately equal, the stratification was accomplished by simply placing an equal number of students from each of the three grade levels into each experimental group. Thus, if twelve students were needed for a particular test administration, the four students at the top of each randomized grade list were called.

*Organization of the Testing Situations*

Group $a_1b_1$ (no auditory isolation in an individual carrel) consisted of two sub-groups of 12 students each. Each student was seated in an individual carrel which contained a small speaker as a sound source.

Group $a_2b_1$ (auditory isolation in an individual carrel) had the same composition and arrangement as Group $a_1b_1$ except that instead of listening to a small speaker, each student wore headphones.

Group $a_1b_2$ (no auditory isolation in a small group) consisted of four sub-groups of six students each. Each sub-group of six was seated in a roughly circular arrangement in a small seminar room. The sound sources used in the seminar room were the speakers contained within the tape recorder.

Group $a_2b_2$ (auditory isolation in a small group) had the same composition and arrangement as Group $a_1b_2$ except that each student wore headphones.

Group $a_1b_3$ (no auditory isolation in a class-size group) consisted of 24 students seated in a normal classroom arrangement. The sound sources used were the two extension speakers provided with the tape recorder.

Group $a_2b_3$ (auditory isolation in a class-size group) had the same composition and arrangement as Group $a_1b_3$ except that each student wore headphones.

*Sequence of Administration*

The Listening Test was administered to the experimental groups in the following sequence:

| | | |
|---|---|---|
| Day 1 | Group $a_1b_1$ | (no auditory isolation in an individual carrel) |
| Day 2 | Group $a_2b_1$ | (auditory isolation in an individual carrel) |
| Day 3,4 | Group $a_1b_2$ | (no auditory isolation in a small group) |
| Day 5,6 | Group $a_2b_2$ | (auditory isolation in a small group) |
| Day 7 | Group $a_1b_3$ | (no auditory isolation in a class-size group) |
| | Group $a_2b_3$ | (auditory isolation in a class-size group) |

Two test administrations were made each day, between the hours of 1:30 p.m. and 4:00 p.m.

*Arrangement of Students Within Testing Situations*

No attempt was made to decide the seating position of an individual within his or her testing situation. Instead, each student was allowed to choose his or her own seating position. The rationale for not imposing a seating arrangement upon the students was that a 'normal' listening situation would allow for group determination of the sociometric distribution. In other words, a group assigned by the teacher to a listening activity would not normally also be assigned a particular seating arrangement for that listening activity.

The arrangement of seating positions was constant within each group situation. The carrels, twelve in a row against one wall in the library, are permanent installations. In the small-group situations, the students were arranged at four tables set in a rectangluar formation. Thus the students were in a roughly circular arrangement, five or six feet apart. In the class-size group situation, regular school desks were used. The desks were arranged into four rows of six desks each.

*Procedures in Test Administration*

As the students entered the testing room, their names were checked off against the randomized grade lists. The students were told they could choose any seating posi-

tion that had an answer sheet. On the first administration, during the tape recorded pause for questions, it was determined that the students were not familiar with the answer sheets used. This flaw in the test directions was not discovered in a pilot administration of the Listening Test because the students in the pilot group apparently had used that type of answer sheet before.

Because of this lack of clarity, a further explanation of the proper method of recording answers was made by the investigator during the initial and all subsequent administrations.

After the explanation, the tape was started. The students that used headphones were instructed to don them immediately after the explanation.

Any questions asked during the tape recorded pauses for questions were answered briefly.

When the half-way point of the test was reached, the students were allowed to get up and stretch or walk around for approximately one minute. They were then asked to return to their seats and the testing resumed. After the test was completed, the students were again asked not to discuss the test with their classmates, and were sent back to their classrooms.

Each administration of the test took approximately 70 minutes.

## Statistical Procedures Employed

The student response sheets were machine-scored to generate International Business Machine punch-cards. The cards were used with the computer program ANOV25 (Division of Educational Research Services, 1968) to yield a two-way analysis of variance, a test for additivity (significance of interaction effects), and cell means and variances.

The results of the Listening Test were also subjected to an item analysis procedure through the use of the program TESTØ4 (Division of Educational Research Services, 1968). The findings of the item analysis are reported in Appendix G.

## Summary

A 2 × 3 posttest only control group design was used, with 24 students, stratified according to grade level and assigned randomly, in each of the six cells. The independent variables were two levels of auditory isolation (no headphones; headphones) and three levels of social isolation (individual; small group; class-size group). The *Lewis Listening Test* was slightly modified and recorded on audio tape, then administered to fourth-, fifth-, and sixth-grade students in one elementary school. The 144 students were tested under six different physical environments: (a) no headphones in an individual carrel, (b) headphones

in an individual carrel, (c) no headphones in a small group, (d) headphones in a small group, (e) no headphones in a class-size group, and (f) headphones in a class-size group. The test administrations took place over a period of seven consecutive school days. The answer sheets were machine-scored and the data subjected to a two-way analysis of variance and an item analysis.

# CHAPTER IV

## FINDINGS AND STATISTICAL ANALYSES

The scores obtained on the Listening Test were classified according to group membership and are presented in this chapter. The data were subjected to a test for interaction effects and a two-way analysis of variance. The results of those tests are reported herein. Examination of the data led to the formulation of an *a posteriori* hypothesis. The results of the *t* test used to test the *a posteriori* Hypothesis IV are reported in this chapter.

The Listening Test results were also subjected to an item analysis; these results are reported in Appendix G.

### Findings

The raw scores for each treatment group are reported in Appendix F, and histograms depicting these data are shown in Figure 1. Table 1 shows the cell means, sample variances, and estimated population variances for the six treatment groups.

#### *Means*

Within this section, and those following, the word *means* is to be interpreted as the average scores

attained on the Listening Test by students in the various physical environments investigated.

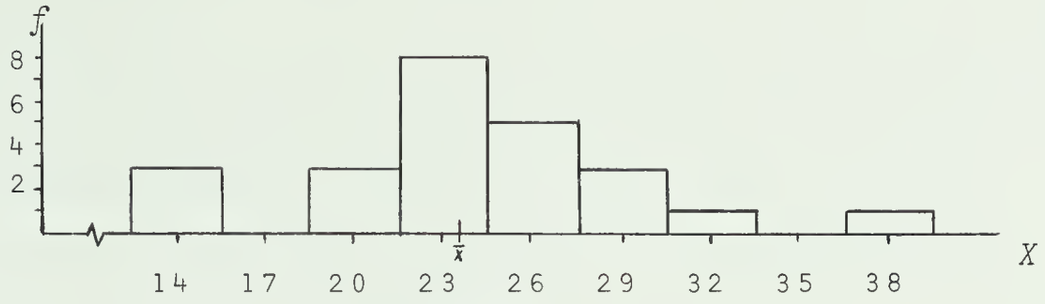
As is evidenced by Figure 1 and Table 1, the means of all the cells are quite similar.

For the situations involving no auditory isolation, the mean score for the small-group level of social isolation was somewhat higher than the mean score for the individual level of social isolation. Although the mean score for the class-size group level of social isolation was slightly lower than the mean score for the small-group level of social isolation, it was still higher than the mean score for the individual level of social isolation. It is obvious that the differences among all three means were small.

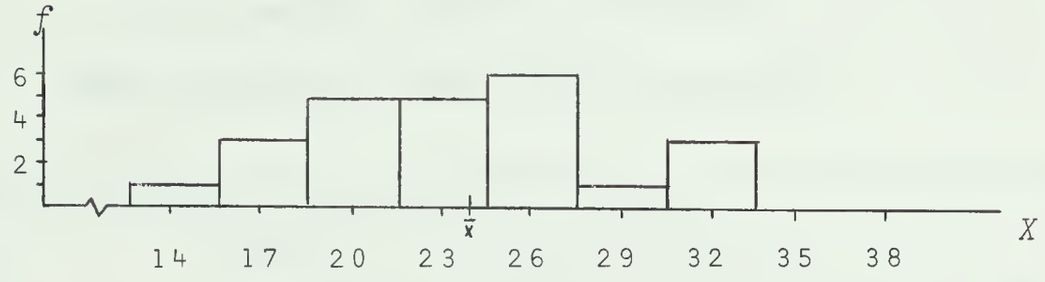
Within the situations involving auditory isolation, the mean score for the individual level of social isolation was again the lowest of the three means. The mean for the small-group level of social isolation was somewhat higher than the mean for the individual level of social isolation, and the mean for the class-size group level of social isolation was slightly higher than the mean for the small-group level of social isolation. Again, the differences among the means were small.

Within the individual level of social isolation, the means for the group that had auditory isolation and the

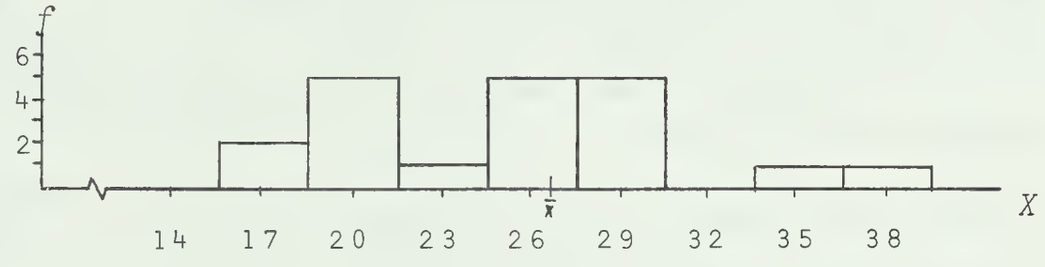
Cell 1 ($a_1b_1$)



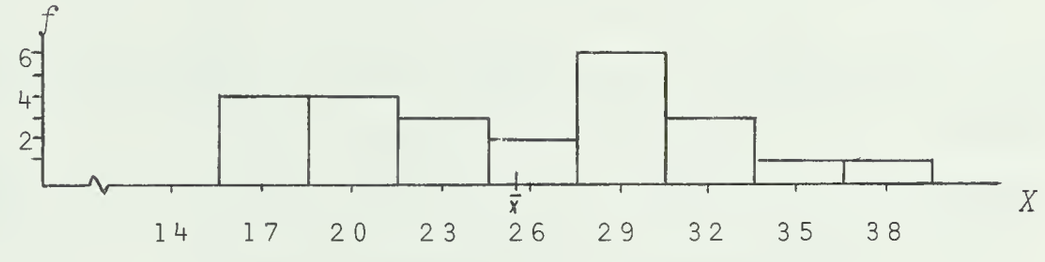

Cell 2 ($a_2b_1$)



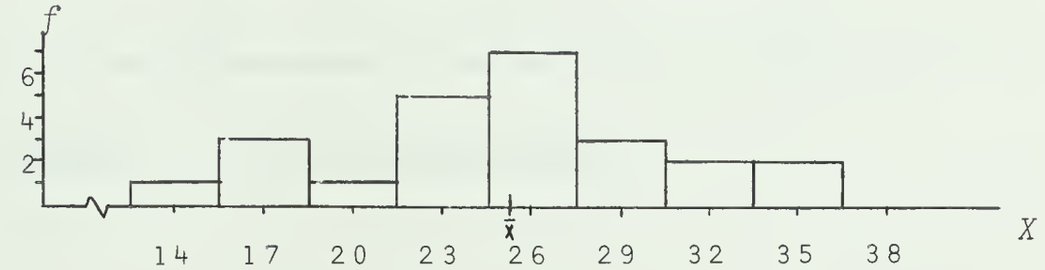

Cell 3 ($a_1b_2$)




Cell 4 ($a_2b_2$)




Cell 5 ($a_1b_3$)




Cell 6 ($a_2b_3$)

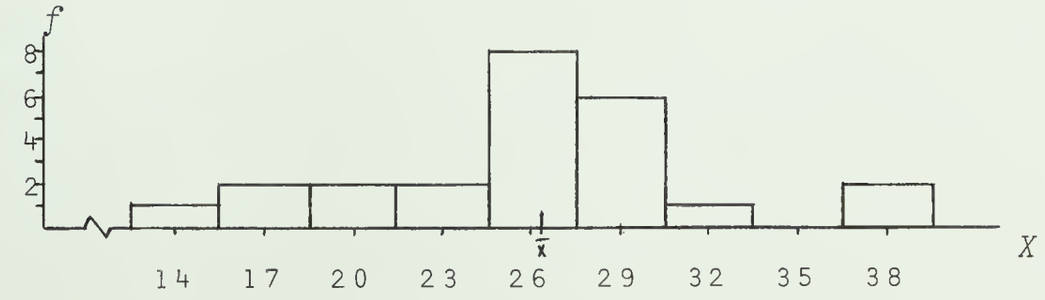



Figure 1: Raw Score Histograms for Each Cell

TABLE 1

CELL MEANS, SAMPLE VARIANCES,

AND ESTIMATED POPULATION VARIANCES

| Degree of Auditory Isolation (Variable A) | Degree of Social Isolation (Variable B) | | |
|---|---|---|---|
| | Individual ($B_1$) | Small Group ($B_2$) | Class-size Group ($B_3$) |
| No Auditory Isolation ($A_1$) | $\overline{X} = 23.58$<br>$s^2 = 28.08$<br>$\hat{\sigma}^2 = 29.30$ | $\overline{X} = 26.54$<br>$s^2 = 31.66$<br>$\hat{\sigma}^2 = 33.04$ | $\overline{X} = 25.29$<br>$s^2 = 31.21$<br>$\hat{\sigma}^2 = 32.56$ |
| Auditory Isolation ($A_2$) | $\overline{X} = 23.63$<br>$s^2 = 23.57$<br>$\hat{\sigma}^2 = 24.59$ | $\overline{X} = 25.54$<br>$s^2 = 35.75$<br>$\hat{\sigma}^2 = 37.30$ | $\overline{X} = 26.29$<br>$s^2 = 33.29$<br>$\hat{\sigma}^2 = 34.74$ |

Note: $n = 24$ for each cell.

group that had no auditory isolation were almost identical, while in the small-group level of social isolation, the group that had no auditory isolation had a mean slightly higher than the group that had auditory isolation. In the class-size group level of social isolation, the mean of the group that had no auditory isolation was slightly lower than the mean of the group that had auditory isolation.

*Variances*

A perusal of the estimated population variances ($\hat{\sigma}^2$) reported in Table 1 shows that the students in the individual level of social isolation with auditory isolation had the least variability, while the students in the small-group level of social isolation with auditory isolation had the greatest variability. These data indicate that students in the individual level of social isolation with auditory isolation had scores that tended to be nearer the mean score for their group than did students in other groups, and that students in the small-group level of social isolation with auditory isolation tended to have scores farther from the mean score for their group than did students in other groups.

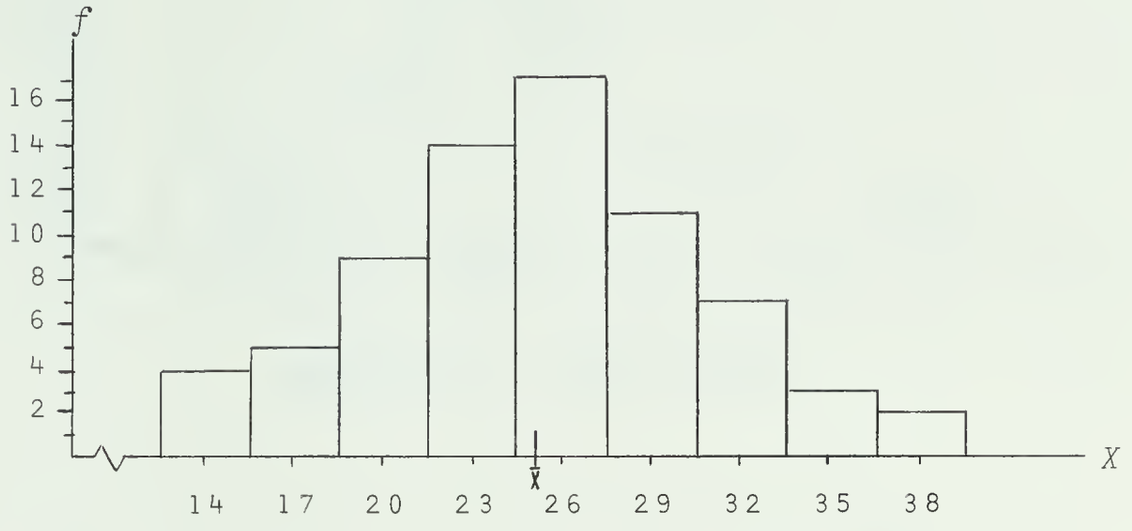
However, Bartlett's test for homogeneity of variance (Winer, 1962, p. 92) yielded a value of $\chi^2 = 1.18$. Since this value of $\chi^2$ did not exceed the critical value

of 11.07 (for $df = 5$, $\alpha = .05$), the estimated population variances cannot be considered significantly different. The variances of the populations were considered homogeneous.

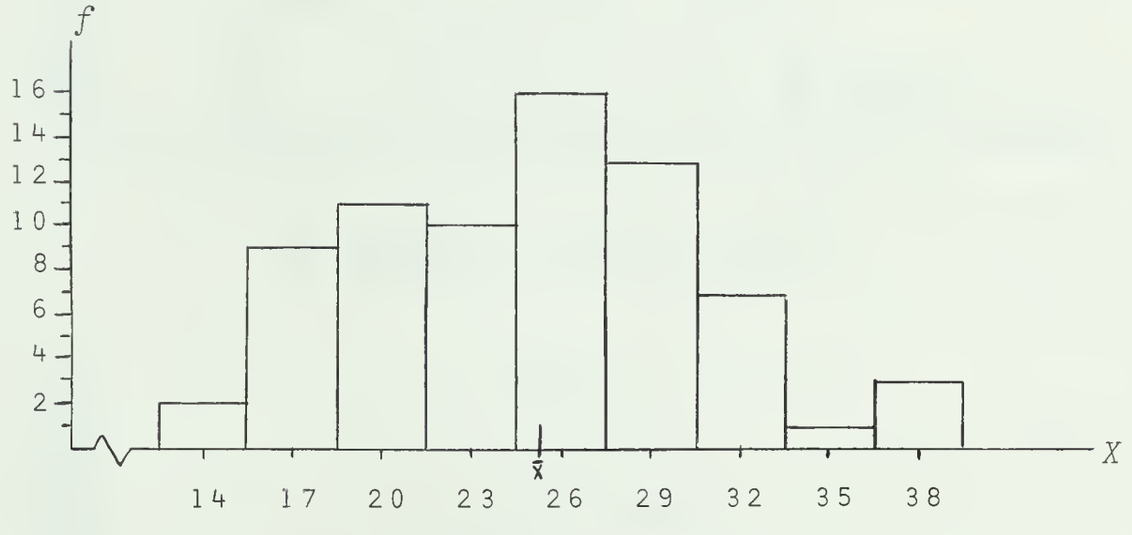
Figure 2 shows the histograms for the two levels of variable A (degree of auditory isolation). It was on the distributions shown that the main effects for variable A were tested. Figure 3 shows the histograms for the three levels of variable B (degree of social isolation). The main effects for variable B were evaluated on the distributions depicted.

## An *A Posteriori* Hypothesis

An examination of the cell means listed in Table 1 showed that while the two means for the individual level of social isolation with no auditory isolation and the individual level of social isolation with auditory isolation were almost identical, the means for the cells involving the other degrees of social isolation were somewhat higher. This observation led to the formulation of an *a posteriori* null hypothesis that there is no significant difference in Listening Test score means between students tested in an individual social environment and students tested in group social environments, disregarding the degree of auditory isolation involved. For this hypothesis,

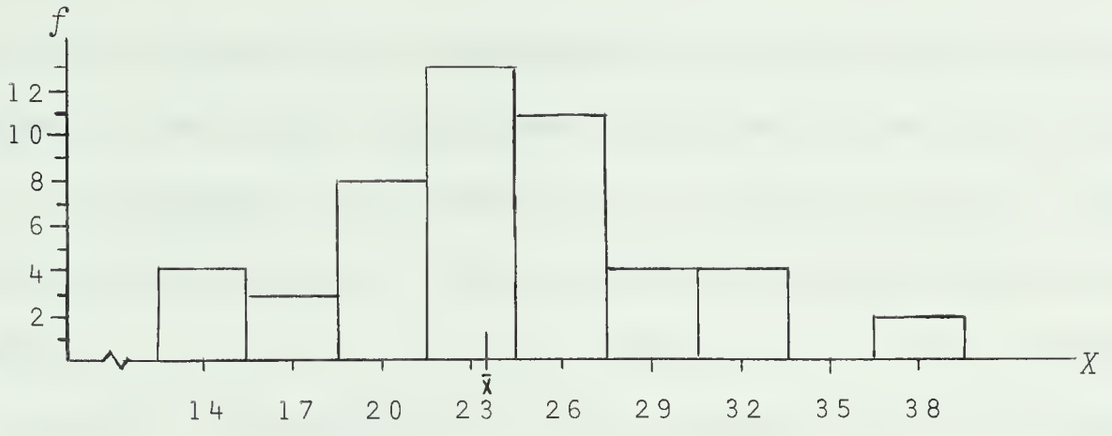



Variable $a_1$ (No Auditory Isolation)

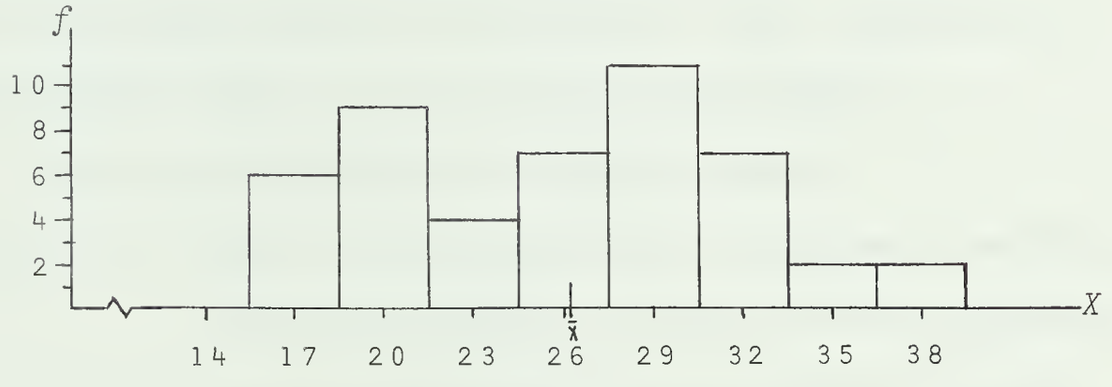



Variable $a_2$ (Auditory Isolation)

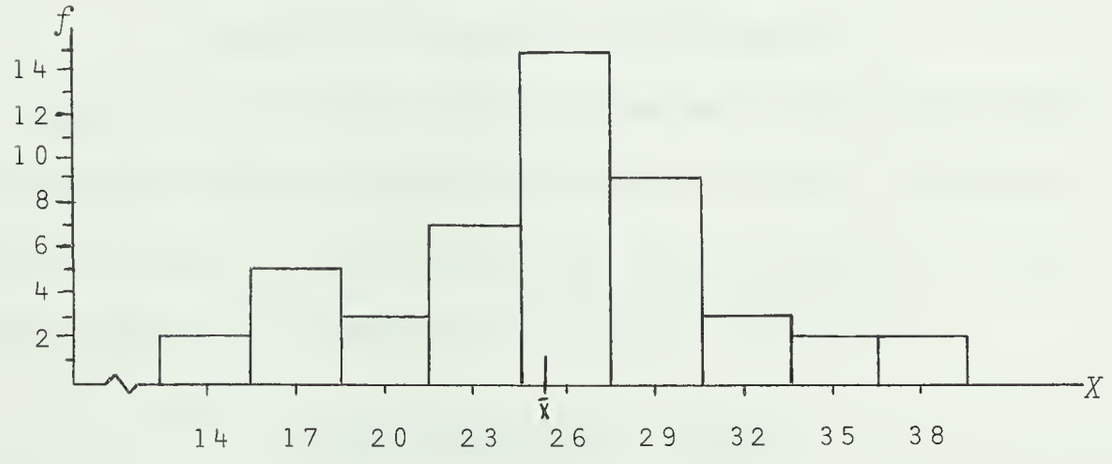
Figure 2: Histograms for Levels of Variable A (Degree of Auditory Isolation)




Variable $b_1$ (Individual)




Variable $b_2$ (Small Group)




Variable $b_3$ (Class-size Group)

Figure 3: Histograms for Levels of Variable B (Degree of Social Isolation)

groups $a_1b_1$ (no auditory isolation in an individual social environment) and $a_2b_1$ (auditory isolation in an individual social environment) were combined to form one group, labeled *individual environment.* The remainder of the groups, $a_1b_2$ (no auditory isolation in a small-group social environment), $a_2b_2$ (auditory isolation in a small-group social environment), $a_1b_3$ (no auditory isolation in a class-size group social environment), and $a_2b_3$ (auditory isolation in a class-size group social environment), were combined to form a second group, called *group environment.*

The null hypothesis is stated below:

Hypothesis IV There is no significant difference at the .05 level between the mean scores attained on the Listening Test by students tested in an individual environment and students tested in a group environment.

Hypothesis IV was formulated and tested in order to investigate the possibility that dividing variable B (degree of social isolation) into three distinct levels may have masked out effects of social isolation.

## Null Hypotheses Tested

The following null hypotheses were tested:

Hypothesis I There is no significant difference at the .05 level between the mean scores attained

on the Listening Test by students in auditory isolation and students not in auditory isolation.

Hypothesis II There is no significant difference at the .05 level among the mean scores attained on the Listening Test by students in the following levels of social isolation: (a) individual, (b) small group, and (c) class-size group.

Hypothesis III There are no significant differences at the .05 level in the mean scores on the Listening Test produced by the interaction of auditory and social isolation.

Hypothesis IV There is no significant difference at the .05 level between the mean scores attained on the Listening Test by students tested in an individual environment and students tested in a group environment.

## Results of Statistical Analyses

The scores obtained on the Listening Test were subjected to a two-way analysis of variance, the calculations for which were carried out on an International Business Machines 360/67 computer, employing a Fortran IV program, ANOV25 (Division of Educational Research Services, 1968).

Additional calculations were done by means of a remote terminal connected to the 360/67 computer.

The Listening Test results were subjected to an item analysis, using the computer program TESTØ4 (Division of Educational Research Services, 1968). The essentials of that item analysis are reported in Appendix G.

*Two-way Analysis of Variance*

Null hypotheses I, II, and III were tested by means of two-way analysis of variance.

First the effects of interaction of variables A (degree of auditory isolation) and B (degree of social isolation) were tested. The test for interaction would yield a significant *F* ratio if one or more particular combinations of the degrees of auditory isolation and the degrees of social isolation produced a cell mean or means so different from what would be predicted for the effects of auditory isolation and social isolation taken independently that the difference could not be considered due to chance if the null hypothesis were true.

The results of the test of interaction effects are summarized in Table 2. The *F* ratio obtained in the test of interaction effects did not exceed the critical *F* ratio, hence the interaction effects cannot be considered significant at the .05 level. Therefore, Hypothesis III,

stating that there is no significant difference at the .05 level in the mean scores on the Listening Test produced by the interaction of auditory isolation and social isolation, cannot be rejected.

Since the interaction effects were not significant, the statistical model was considered additive and the interaction effects were combined with the error term for the two-way analysis of variance.

The results of the two-way analysis of variance are summarized in Table 3.

The value of less than 0.01 for the *F* ratio on variable A (degree of auditory isolation) means that Hypothesis I, stating that there is no significant difference at the .05 level between the mean scores attained on the Listening Test by students in auditory isolation and students not in auditory isolation, cannot be rejected. The non-rejection of Hypothesis I suggests that auditory isolation had virtually no effect on the Listening Test scores obtained within the three degrees of social isolation investigated.

For variable B (degree of social isolation) the *F* ratio obtained was 2.73. The obtained value led to the decision that Hypothesis II, stating that there is no significant difference at the .05 level among the means attained on the Listening Test by students in the following

TABLE 2

TEST OF INTERACTION EFFECTS

| Source | *SS* | *MS* | *df* | *F* |
|---|---|---|---|---|
| A × B | 23.94 | 11.97 | 2 | 0.37 |
| Error | 4405.37 | 31.92 | 138 | |

$F_{0.5}(2,138) = 3.07$

TABLE 3

TWO-WAY ANALYSIS OF VARIANCE

| Source | *SS* | *MS* | *df* | *F* |
|---|---|---|---|---|
| A (Auditory Isolation) | 0.01 | 0.01 | 1 | <0.01 |
| B (Social Isolation) | 172.62 | 86.31 | 2 | 2.73 |
| Error | 4429.31 | 31.64 | 140 | |

$F_{0.5}(1,140) = 3.92$ $F_{0.5}(2,140) = 3.07$

degrees of social isolation: (a) individual, (b) small group, and (c) class-size group, could not be rejected. The non-rejection of Hypothesis II indicates that none of the three degrees of social isolation produced a significant effect on the Listening Test scores obtained within the two degrees of auditory isolation investigated.

### t *Test*

A *t* test was applied to test the *a posteriori* Hypothesis IV. For the *t* test, the degree of auditory isolation was disregarded, since the two-way analysis of variance showed that auditory isolation had no significant effect on the Listening Test scores obtained. Hence, groups $a_1b_1$ (no auditory isolation in an individual social environment) and $a_2b_1$ (auditory isolation in an individual social environment) were combined to form one group, called individual environment. The remainder of the groups, comprising the small-group and class-size group social environments, crossed with the two levels of auditory isolation, were combined to form a second group, labeled group environment.

Table 4 summarizes the data relevant to the *t* test. The obtained value of *t* indicates that Hypothesis IV, stating that there is no significant difference at the .05 level between the mean scores attained on the Listening Test

TABLE 4

$t$ TEST BETWEEN INDIVIDUAL AND GROUP ENVIRONMENTS

| | Individual Environment | Group Environment |
|---|---|---|
| $\bar{X}$ | 23.60 | 25.92 |
| $s^2$ | 25.82 | 33.24 |
| $n$ | 48 | 96 |
| $t$ | 2.37* | |

$t_{.05}(df = 138) = 1.98$

$t_{.02}(df = 138) = 2.36$

*$p < .05$

by students tested in individual carrels and students tested in groups, must be rejected. The rejection of Hypothesis IV indicates that the difference between the means of the scores of the students tested in the individual environment and the scores of the students tested in the group environment is significant at the .05 level.

It is imperative that recognition be given to the fact that the formulation of Hypothesis IV, and its subsequent rejection, is, in a sense, the result of manipulating data after the fact. This study did not have as one of its purposes the testing of differences between Listening Test scores obtained in an individual environment and in a group environment; rather, it attempted to measure Listening Test score differences among three specific degrees of social isolation: individual, small group, and class-size group. Before generalizations can be made about differences in Listening Test scores obtained in individual environments and in group environments, replication is necessary.

## Summary

Although small differences existed among the means of the six cells representing the six different physical environments investigated, a test for interaction effects

and a two-way analysis of variance indicated that the differences among the means were not large enough to cause the rejection of null Hypotheses I, II, and III. The differences observed in the variances of the six groups were shown to be not significant at the .05 level. The *a posteriori* null Hypothesis IV, involving the equality of individual environments and group environments with respect to Listening Test achievement, was rejected.

# CHAPTER V

# CONCLUSIONS AND DISCUSSION

Within this chapter, the conclusions drawn from the statistical testing of the four null hypotheses are described. A discussion of the congruence of the results obtained with those expected on the basis of the intuitive explanations proffered in Chapter I is presented. The chapter concludes with a brief discussion on implications for teaching practice and for future research.

## Conclusions

### *Null Hypothesis I*

Since null Hypothesis I, stating that there is no significant difference at the .05 level between the mean scores attained on the Listening Test by students in auditory isolation and students not in auditory isolation, could not be rejected on the basis of the two-way analysis of variance, the conclusion can be drawn that auditory isolation within the three degrees of social isolation investigated (individual, small group, and class-size group) does not substantially affect listening comprehension as measured by the Listening Test.

*Null Hypothesis II*

Null Hypothesis II, stating that there is no significant difference at the .05 level among the mean scores attained on the Listening Test by students in the following levels of social isolation: (a) individual, (b) small group, and (c) class-size group, was also tested by two-way analysis of variance. Since null Hypothesis II could not be rejected, the conclusion can be drawn that none of the three degrees of social isolation investigated (individual, small group, and class-size group) produced a significant effect on the Listening Test scores obtained within the two degrees of auditory isolation used in the experiment.

In terms of achievement on the Listening Test, none of the three levels of social isolation investigated was superior to any other.

*Null Hypothesis III*

The fact that null Hypothesis III, stating that there are no significant differences at the .05 level in the mean scores on the Listening test produced by the interaction of auditory and social isolation, could not be rejected on the basis of the test for interaction, leads to the conclusion that no significant interaction effects exist between the two degrees of auditory isolation and the three degrees of social isolation investi-

gated. This indicates that no particular combination or combinations of degree of auditory isolation and degree of social isolation could be expected to produce a Listening Test score significantly different from that which would be predicted from the degree of auditory isolation and the degree of social isolation. None of the six physical environments investigated, then, was superior to the others in terms of providing for increased Listening Test scores.

*Null Hypothesis IV*

Null Hypothesis IV, stating that there is no significant difference at the .05 level between the mean scores obtained on the Listening Test by students tested in an individual environment and students tested in a group environment, was formulated after examination of the data indicated that students tested in an individual social environment appeared to score lower on the Listening Test than students tested in a group social environment. Accordingly, the students in the individual level of social isolation, regardless of degree of auditory isolation, were classified as having been in an individual environment, while those in both the small-group and class-size group levels of social isolation, regardless of degree of auditory isolation, were classified as having been in a group environment.

In terms of simple differences between the means, the difference between the means for group environment and individual environment was similar to the difference between the means for the individual level of social isolation and the small-group level of social isolation. Despite the fact that the *F* test showed that the difference between the individual level of social isolation and the small-group level of social isolation was not significant, the *t* test was applied on the basis that it would be a more powerful test, due to the larger number of students involved.

On the basis of the *t* test results, the *a posteriori* Hypothesis IV was rejected at the .05 level of significance.

Because Hypothesis IV was a result of data manipulation, its rejection should be interpreted with caution. The number of students in the social environment group (96) influenced the value of *t* obtained. This study did not have as one of its purposes the testing of differences between Listening Test scores obtained in an individual environment and in a group environment; rather, it attempted to measure Listening Test score differences among three specific degrees of social isolation.

However, rejection of Hypothesis IV can lead to speculations. Perhaps the three specific degrees of social isolation investigated in the study caused a masking effect,

whereby significant differences between students tested in group social environments and students tested in individual social environments are hidden. Perhaps there even exists a critical group size beyond which a significant difference occurs. The *a posteriori* examination of the data indicates that this critical group size might be one (an individual), but no statements can be made with any degree of certainty until replication of this study is done with the aim of identifying differences in Listening Test scores between students tested in individual social environments and students tested in various group social environments.

## Discussion

In The Problem (Chapter I), it was noted that several teachers had commented to the investigator that auditory and social isolation appeared to increase the listening comprehension of students at the upper-elementary and junior high-school levels. Yet no research could be located which would substantiate or refute that subjective assessment.

When this study was undertaken to gain some knowledge relative to effects of auditory and social isolation on listening comprehension, one elementary-school principal expressed surprise. He was so sure that auditory and social

isolation did increase listening comprehension, that he accepted the idea as axiomatic, and could see no reason for its investigation. A few other teachers expressed interest in the study and ventured guesses that a real difference would be found in favor of students in auditory and social isolation.

Yet the results of the present study indicate that auditory isolation does not provide for increased listening comprehension as measured by the Listening Test. The apparent increases in listening comprehension that have allegedly been observed by some teachers (initially discussed in The Problem, Chapter I) did not, in fact, appear as increased Listening Test scores under the conditions investigated in this study.

In addition, according to the findings of this study, there is no indication that any of the three degrees of social isolation investigated in the study (individual, small group, and class-size group) have significant effects on listening comprehension as measured by the Listening Test. The supposition made in The Problem (Chapter I), that placing a student in an individual carrel and thereby eliminating distractions for him, may tend to increase his ability to comprehend oral material, was, in this study, not upheld.

However, an *a posteriori* examination of the data

tends to indicate that students tested in an individual (carrel) social environment score significantly lower on the Listening Test than do students tested in a group environment (small-group and class-size groups combined). This does not necessarily mean that students in a group of any size can be expected to score significantly higher on the Listening Test than students isolated in carrels, however. The present study was not designed to identify a critical group size (if one exists) at which a significant change in Listening Test scores might occur. For this reason, and because of the *t* test group size mentioned on page 67, the results of the *a posteriori* examination of the data should be interpreted with caution, and can best be used as guides for further research.

The 'common-sense' explanation for the allegedly-observed increase in listening comprehension (described earlier in The Problem, Chapter I) likely accounts for the opinion that auditory and social isolation affect listening comprehension. It seems reasonable that auditory and social isolation *should* tend to focus the attention of the student and therefore assist him in comprehending oral material. It seems reasonable that auditory and social isolation *should* mask out distracting sights and sounds, and therefore assist the student in comprehending oral material. It seems reasonable that the novelty of auditory

and social isolation *should* cause the student to pay more attention to the oral material presented, and therefore comprehend more.

Yet, apparently, the logical, "common-sense' explanation is insufficient, as the expected increase in listening comprehension that *should* appear, did not.

Several possible explanations might be advanced for the discrepancy between the 'expected' results and the results obtained in this study.

Firstly, the length of the Listening Test could be an important factor. The Listening Test required approximately 70 minutes for its administration. This length of time far exceeds the usual length of time devoted to one subject by an upper-elementary school class. The length of the test may have exceeded the attention span of the students, causing a masking of effects of auditory and social isolation on listening comprehension.

Frequently in educational research, it is problematic to duplicate a 'normal' classroom situation while gathering measurements, and compromises must be made. Such was the case in the present study. As better (and shorter) tests of listening comprehension become available, replication of this study may lead to different results.

Secondly, the investigation of three grade levels simultaneously could have masked over effects of auditory

and social isolation. Once again, a compromise was made in this study, in that a listening comprehension test developed for three grade levels was used.

Both the first and second possibilities discussed above could probably have been eliminated by using a shorter, single-grade test. However, such a test was, to the knowledge of the investigator, not available, and the problems inherent in developing, validating, and estimating the reliability of such a test were considered beyond the scope of the research project.

Thirdly, a very real possibility exists that the three specific levels of social isolation used in the study masked out effects of social isolation. This possibility has already been discussed in the previous section in this chapter. The possibility of the masking effect appears strong, and further investigation into this phenomenon might be most enlightening.

Finally, it must be considered that the length of the test and the possible masking effect due to the investigation of three grade levels actually had no influence on the Listening Test scores obtained. Logical, 'common-sense' expectations have not always shown themselves to be realistic.

## Implications for Teaching Practice

This study was an initial attempt into an unexplored area. Rather than provide conclusive answers to questions relating to effects of auditory and social isolation on listening comprehension, it generates many new questions.

With respect to providing auditory isolation by means of headphones, the results of this study indicate no advantage, in terms of student gains in listening comprehension as reflected by Listening Test scores, over not providing auditory isolation, within the three degrees of social isolation investigated.

With respect to providing one of the three degrees of social isolation investigated, the results of this study indicate that none of the three degrees of social isolation is better than any other (within the two degrees of auditory isolation investigated), in terms of student gains in listening comprehension as reflected by Listening Test scores.

With respect to combinations of the degrees of auditory and social isolation investigated, the results of this study indicate that none of the six physical environments studied was superior to the others in terms of providing student gains in listening comprehension as measured by the Listening Test.

## Implications for Future Research

The results of the *a posteriori* examination of the test score means show that those students in social, or group, situations performed significantly better than those students in individual, or socially isolated, situations.

These results lead to some interesting questions:

Is man so much of a social animal that he performs poorly with respect to listening comprehension (or any other learning activity) in a situation in which he is isolated?

Does some kind of non-verbal communication occur in a group situation which tends to affect listening comprehension? If so, is it beneficial or detrimental to learning?

Is there a critical group size with respect to efficiency in listening comprehension, so that if the group is smaller than the critical size, listening comprehension is poorer than when the group is larger than the critical size?

Does the existence of a group provide a motivational climate which increases listening comprehension (or any other learning activity), and which is lacking in social isolation within a carrel?

Other questions that need answering arise from the results of this study:

Is the length of the Listening Test critical? Would

the findings be the same with a twenty-minute test or a two-hour test?

Is there a possibility that testing three grade levels simultaneously masked out some effects? Would the findings be similar if only one grade level were tested at a time?

Is the nature of the listening comprehension test utilized critical? Would recorded material presented in different ways (teaching methodologies) provide for different results?

Would the findings be similar or different if material in the affective domain were used? Would an emotion-laden presentation cause different reactions in different auditory and social situations?

## Summary

It was concluded that null Hypotheses I, II, and III could not be rejected. On the basis of this study, there is no indication that auditory isolation within the three degrees of social isolation investigated had an effect on listening comprehension as measured by the Listening Test. Nor was there any indication that the three degrees of social isolation investigated had an effect on listening comprehension as measured by the Listening Test, within the two degrees of auditory isolation investigated. The inter-

action of the two degrees of auditory isolation and the three degrees of social isolation did not affect listening comprehension as measured by the Listening Test.

The rejection of the *a posteriori* Hypothesis IV was interpreted with qualifications; it suggested the need for further research.

A discussion was presented on the possible reasons that the results of this study did not conform with the expectations of some educators.

Finally, implications for teaching practice and for future research were given.

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# APPENDICES

# APPENDIX A

## Transcript of the Orientation Tape

Hello, boys and girls. My name is Mr. Misanchuk. During the next week or two, I will be working with you in your school. I hope you will find what we do together interesting and enjoyable.

Each one of you will be given an opportunity to listen to a tape recording, then you will be asked questions about what you heard. The tape recording is just a test of how well you can listen. The listening test you take part in will not be counted as part of your school work.

I still want you to do as well as you can when you listen to the tape and answer the questions.

Not all of you will be listening to the tape at the same time. Some days two or three of you will be asked to come and listen, while other days more of you will be asked. The fact that some of you come on the first day or last day is not important--the order in which you will be called is the result of pulling names from a hat. Everyone will get a chance to take part, so don't be disappointed or frightened if you are called first, last, or in the middle.

Also, you will not all take the test in the same place. Some of you will be taking the test in a classroom, some in a conference room, and some in the carrels in the library. Again, where you take the test is not important.

Please do not discuss the test with your classmates. Your teacher and I are trying to find out something about

how children learn best, so that we can help to make learning easier and more enjoyable for you. If you discuss the test with a friend, you might be preventing your teacher and me from finding out what we want to know. So even if your very best friend asks you what you did, please don't tell him or her. Just say, "Wait till your turn comes, and you'll see."

After we're all finished, your teacher will explain to you what we found out, and will let you discuss what happened.

All the grade fours, fives, and sixes are helping your teacher and me with this project, so remember not to discuss the test with your friends in other grades, either.

That's all for now. Thank you for being such good listeners. I'll be seeing you soon.

# APPENDIX B

## Transcript of the Listening Test

Hello again, boys and girls. You have taken many reading tests to find out how well you can read. This is an exercise to find out how well you can listen. I will read several selections to you. After each selection is read, I will ask you questions about the selection.

You will see before you an answer sheet and a sheet of paper with some numbers in rectangles. For now, do not pay any attention to the numbers in the rectangles. They refer to some questions later in the exercise, and you will be told when to refer to them.

Before we go any further, print your last name, then your first name, in the space at the top of the answer sheet. You need not fill in the other blanks.

*Pause for approximately ten seconds.*

All the questions I ask you will be multiple-choice. I will ask a question, then give four possible answers. You will be expected to choose the best answer from among the four choices given. The first time I ask the question, listen to all the answers, without marking anything down. When I read the same question again, choose the answer that you think is correct, and mark your choice on the answer sheet.

To mark your answer sheet correctly, first make sure that you are looking at the correct question number. Choose your answer, either A, B, C, or D, and fill in the space

between the dotted lines of your choice. Look at the top center of your answer sheet for an example of how the spaces should be filled in. Do you all see it?

*Pause for approximately five seconds.*

Now, let's try a sample question or two. Here is a sample selection:

EXAMPLE

A large part of the school day is spent in listening. We listen to the teacher as she gives directions, explains an assignment, or reads a story to the class. We listen to other boys and girls as they give reports, discuss problems, and read orally. We listen to music and we listen to noise. In fact, we spend more time listening than we do reading, writing, or speaking.

Example question one: The main idea in this selection is:

(a) we should learn how to listen

(b) we spend much of our time in classroom listening

(c) all pupils are good listeners

(d) listening is more important than reading

I will repeat the question.

*Question repeated. For the remainder of this transcript, it can be assumed that each question was repeated in its entirety. A five-second pause followed*

*each repetition.*

Since the selection was about how much time we spend in listening, the correct answer is (b). Make a heavy mark in the space below (b) on the answer sheet, next to number one.

Here is the second example question: One might infer from this selection that:

(a) it is important to be a good listener

(b) we should listen to everything

(c) good listeners are always good students

(d) it is not important to listen

When we infer something it means to decide or draw a conclusion from the facts given. Which inference can we make from the facts given in this selection? I will repeat the question for you.

*Question repeated.*

Now think to yourself: Yes, it is important to be a good listener, because we spend so much of our time in the classroom listening. Make a heavy mark in the space below (a) on the answer sheet, next to number two.

There will be questions in the test where you will be asked to select the main idea in the selection. Other questions will ask you to make an inference like the one you have just made. In addition, there will be questions about certain details in the selections, and questions

about the meanings of certain words as they are used in the selection.

Do you understand how to mark your answer? If you do not, please raise your hand right now.

*Pause for approximately fifteen seconds to answer any questions.*

Be sure to mark heavy enough. If you wish to change your answer, you may erase. Be sure to mark only one answer for each question. Answer every question. If you are not sure of the answer, make the best guess you can. There will be no penalty for wrong answers.

If you have any questions about the directions I have just given you, please raise your hand.

*Pause for approximately fifteen seconds to answer any questions.*

Now, here is the first selection:

FARMER ANTS

Some red ants are good farmers. They build rooms in their houses for gardens. Into these gardens they carry leaves. The leaves are kept damp. Tiny plants grow on the leaves. Those tiny plants are used for food. The gardener ants live in Texas and South America.

Still other ants make rooms called granaries, in which they store seeds. They build very good roads leading to the farmers' grain. Back and forth go the ants, carrying

kernels of grain and storing them for food in their granaries.

Question number 1: The main idea of this selection is:

(a) gardener ants live in Texas

(b) some ants are farmers

(c) ants build gardens in their homes

(d) ants store grain in their granaries

Choose your answer and mark it, as I read the question again.

*Question repeated.*

Question number 2: The color of the ants described in this selection is:

(a) brown (b) white

(c) red (d) black

Question number 3: One might infer from this selection that:

(a) all ants are farmers

(b) ant granaries are found only in Texas

(c) ants eat plants and grain

(d) gardener ants build granaries in their homes

Question number 4: The word FORTH in this selection means:

(a) number four (b) build

(c) out (d) forward

Here is the next selection:

FLYING MACHINES

In 1878, the Reverend Bishop Milton Wright left his home in Dayton, Ohio to visit New York City on business. When it was time for him to return he looked in the shop windows for a gift that he could take his two sons, Wilbur and Orville Wright. He saw books, handkerchiefs, and neckties, and he also saw an odd mechanical toy labelled "flying machine".

These two boys were very much interested in any type of mechanical instrument, so the bishop went into the store to examine the "flying machine". It had wings, and was driven by a cardboard propellor that turned by the untwisting of a heavy rubber band. It was a fascinating toy, and the bishop carried it home feeling his sons would be pleased.

Question number 5: When did this incident happen?

(a) 1875 (b) 1878

(c) 1898 (d) 1913

Question number 6: One might infer from this selection that:

(a) the bishop's boys did not like neckties

(b) the airplane had been invented

(c) the bishop knew how to please his sons

(d) the bishop had never taken his boys a gift before

Question number 7: The word FASCINATING in this selection means:

(a) lasting (b) delightful

(c) beautiful (d) mechanical

Question number 8: The main idea in this selection is:

(a) all boys like mechanical toys

(b) Bishop Wright chose a gift which he knew his boys would like

(c) the airplane was invented by the Wright brothers

(d) the Wright brothers were pleased with the gift from their father

Here is the next selection:

PRIMARY SEPARATION AREA

All mail is sorted two times before it leaves the post office. The first sorting is done to segregate the mails destined for one general area. This primary sorting is done along rows of cases that are divided equally into many small compartments, with a twelve inch wide shelf below the compartments to hold the mail. Each compartment is labeled for a very large city like Montreal or Winnipeg, for a province, for a group of provinces like the prairie provinces, or for foreign delivery. The cancelled mail is put on the shelf and sorted into the compartments according to its destination. Each sorting case is like the next

one in the row so that clerks can work at any case with ease.

Question number 9: The main idea in this selection is:

(a) cancelled mail is first sorted into compartments according to its destination

(b) mail is cancelled before it is sorted

(c) mail is sorted by clerks

(d) mail is sorted into cases according to its general destination

Question number 10: How many inches wide is the shelf below the compartments?

(a) 6 (b) 8

(c) 10 (d) 12

Question number 11: According to this selection, a letter addressed to 2400 Dawson Avenue, Winnipeg, Manitoba, would first be placed in the compartment labelled:

(a) Manitoba (b) Dawson Avenue

(c) Prairie Provinces (d) Winnipeg

Question number 12: The word SEGREGATE in this selection means:

(a) separate (b) collect

(c) cancel (d) work

Here is the next selection:

GEORGE EASTMAN

George Eastman was born in Waterville, New York, July 12, 1854. When he was six years old his family moved to Rochester, New York, where he has resided ever since. When George was seven years old his father died. Though the family had very little money, Mrs. Eastman kept her son in school until he was fourteen years old, at which time it was necessary for him to go to work.

Later this boy, after overcoming many obstacles, wrote the sentence "You press the button and we do the rest." Today, because of his famous invention, the kodak, he is worth many millions of dollars, every cent of which he earned by using his brain.

Some years ago, the president of the Massachussetts Institute of Technology announced that two million, three hundred thousand dollars had been given to the school by someone who did not wish his name to be known. He said the gift was from "Mr. Smith". A year or so later another gift of several millions came from "Mr. Smith". And at last, after a total of eleven million dollars had been presented to the school, it was discovered that George Eastman was the man who had hidden his identity under the name of "Mr. Smith".

Question number 13: How old was George Eastman

when his father died?

(a) 6 (b) 7

(c) 11 (d) 14

Question number 14: From this story one might infer that George Eastman:

(a) made his money easily

(b) wished to be a poor man

(c) gave his money away because he had too much

(d) wanted to help others get an education

Question number 15: The word OBSTACLES in this selection means:

(a) hindrances (b) hardships

(c) debts (d) inventions

Question number 16: The main idea of this selection is:

(a) George Eastman made good use of his life

(b) George Eastman invented the kodak

(c) George Eastman was a poor boy

(d) George Eastman made his millions easily

Here is the next selection:

THE MATCH FACTORY

Would you like to visit a match factory where a giant machine can turn out twenty-four million matches in a single day? Very little work there is done by hand. The story begins with planks of pine wood two inches thick from which

the bark and all knotty and cross grained pieces have been removed. After the planks are thoroughly dried, they are placed in machines which slice them into strips the exact thickness of a match. The machine then cuts and splits the strips into match lengths. The match sticks are placed in trays and thoroughly dried in a kiln, and then taken up by a machine and placed side by side.

The sticks are now ready for dipping. The moving belts bristling with thousands of match sticks, look like row upon row of giant scrubbing brushes. These belts, carrying the army of tiny match soldiers standing rigid at attention, pass over rollers which revolve in tanks containing the liquid materials for the tip. Each match is touched with just the right amount of each substance that is needed.

Question number 17: The main idea in this selection is:

(a) matches are important

(b) matches are made of wood

(c) matches are made by giant machines

(d) matches are made by hand

Question number 18: From what kind of wood are matches made?

(a) spruce (b) fir

(c) pine (d) cedar

Question number 19: The word RIGID in this selection means:

(a) stiff (b) strict

(c) tall (d) small

Question number 20: One might infer from this selection that:

(a) matches can not be made by hand

(b) the wood from which matches are made comes from the far north

(c) match sticks are cut and split by different machines

(d) it is important that the wood in matches be dry

Here is the next selection:

THE DEATH RATE

One of the greatest achievements of modern times is the reduction of the death rate, due to the discoveries of medical science, and to the improvements in cooperative measures for health protection. The death rate in this country is now about eight, that is, there are annually about eight deaths among each one thousand of the population. It is safe to assert that fifty years ago it was at least twice as high as it is now. In former ages it was doubtless from three to five times as high; and is yet in backward countries.

Question number 21: The main idea in this selection is:

(a) the death rate is increasing

(b) the death rate today is high

(c) the death rate is decreasing

(d) the cost of sickness is high

Question number 22: Our present death rate in Canada is about how many per thousand?

(a) 6 (b) 8

(c) 12 (d) 25

Question number 23: The word ANNUALLY in this selection means:

(a) usually (b) often

(c) sometimes (d) yearly

Question number 24: From this selection one might infer that the death rate in the future will:

(a) continue to decrease

(b) continue to increase

(c) remain the same

(d) have no effect upon social life

I imagine you must be getting a little bit tired of sitting there, working so hard. Do you think we should take a few minutes for a break? You may get up and stretch if you like, but please don't discuss the questions on the test with anybody else taking the test. I will tell you

when we will start again.

*Pause for approximately one minute.*

Here is the next selection:

JOHN'S NEW BICYCLE

When John was a small boy he longed to have a shiny new bicycle, so he worked hard and long at odd jobs, such as shovelling snow from the neighbor's sidewalks and delivering orders on busy Saturdays for the village grocer. Little by little his fund of money grew. Every Saturday night he counted it as a miser counts his gold, and night after night he had glorious dreams in which he found himself dashing along a boulevard on his steed of shining steel and gleaming nickel. At last the great day came when he had enough to buy the object of all his dreams and longings. But strange to say, the actual bicycle gave him only a fraction of the joy he had found in dreaming of it and working for it. Two years after its purchase it stood, rusty and neglected, in a corner of the cellar from which it emerged only occasionally when John was obliged to go on some errand to the neighboring village a few miles away.

Question number 25: The main idea in this selection is:

(a) John bought a new bicycle

(b) John was disappointed with his new bicycle

(c) John enjoyed earning the money more than he did his new bicycle

(d) John saved money to buy a bicycle

Question number 26: One might infer from this selection that:

(a) John needed a new bicycle badly

(b) John liked to ride a bicycle

(c) John was sorry he bought a bicycle

(d) John did not need a bicycle

Question number 27: John earned the money to purchase his bicycle by:

(a) carrying papers

(b) selling magazines

(c) working in a grocery store

(d) delivering groceries

Question number 28: The word LONGED in this selection means:

(a) desired earnestly (b) tried hard

(c) worked faithfully (d) dreamed

Here is the next selection:

WHY WE WEAR CLOTHING

Clothing protects the body against exposure to heat, rain, and wind, particularly against exposure to cold. In tropical regions uncivilized man wears little or no clothing; in arctic regions he wears animal skins as a protection

against biting cold and bleak winds.

Civilized man wears clothes, whether he lives in northern countries or in balmy southern countries; but he modifies his clothing to suit the various temperatures. In cold climates he wears heavy woolens and furs; in warm climates, thin cottons and linens; in winter he has additional clothes for out-of-door wear; in summer he discards the out-of-door clothes and uses the thinnest and lightest materials for all purposes.

Question number 29: The word MODIFIES in this selection means:

(a) changes (b) increases

(c) decreases (d) protects

Question number 30: The main idea in this selection is:

(a) clothing is worn by all people

(b) civilized man wears more clothing than uncivilized man

(c) clothing is worn for protection

(d) uncivilized man wears little or no clothing

Question number 31: In warm climates civilized man wears:

(a) thin cottons and linens

(b) little or no clothing

(c) woolens and furs

(d) additional clothes

Question number 32: From this selection one might infer that:

(a) clothing is worn only for protection

(b) uncivilized man lives only in warm climates

(c) civilized man varies his clothing according to the season

(d) civilized man does not live in warm climates

Here is the next selection:

HOW EXCHANGE TAKES PLACE

Among primitive people, few kinds of goods were produced, and the wants of all people were much alike. But even then there was some kind of exchange of goods.

The simplest form of exchange is, naturally, the transfer of one thing for another. A farmer may raise hens and take their eggs into town and trade them at a store for coffee and sugar. That is direct exchange of one thing for another, and is known as barter. When Indians first met white men, that kind of trade took place. The Indian might trade valuable skins or square miles of land for a few knives or a few pieces of bright cloth or perhaps "fire water".

But barter had very ancient limitations. If you want a pair of shoes and the only means of getting them is by exchanging something you have already or going to work for the shoemaker, you may wait a long time before you go

so far. A manufacturer of steel rails cannot live on those things. He must trade them to somebody else and perhaps make two or three other trades before he can get something to live on for his steel rails.

The way out is, of course, to find something which everybody will take in exchange for anything he has to dispose of. A thing that everybody is willing to accept for goods or services we call money. With money you can buy the things you want, because the money you give to someone else, he can in turn pass on to others and obtain the things he is anxious to have.

Question number 33: The simplest form of exchange is known as:

(a) trade (b) money

(c) goods (d) barter

Question number 34: The main idea in this selection is:

(a) Indians did not need money

(b) money makes exchange easier

(c) barter would work today

(d) primitive people did not exchange goods

Question number 35: The word GOODS in this selection means:

(a) commodities (b) cloth

(c) textiles (d) skins

Question number 36: One might infer from this selection that:

(a) barter is never used today

(b) money is used more than barter today

(c) white men invented money

(d) Indians preferred bright cloth to money

Here is the next selection:

POVERTY, PAUPERISM, AND THEIR CAUSES

More people have probably suffered from poverty than from any other handicap except ignorance. Poverty does not mean merely a condition in which one cannot enjoy everything he would like, but rather a state in which one must live at a standard below what is necessary for health and comfort. Pauperism is a still lower level. That term implies that outside help is required in order to keep alive. It has been estimated that even in so-called good times at least two million people in Canada are living at one or the other of these levels.

Question number 37: The main idea in this selection is:

(a) poverty and pauperism are the same

(b) many people suffer from poverty and pauperism

(c) poverty is worse than pauperism

(d) we will always have poverty

Question number 38: The word HANDICAP in this selection means:

(a) helpless (b) suffer

(c) unfortunate (d) hindrance

Question number 39: One might infer from this selection that:

(a) we will always have poverty and pauperism

(b) more people suffer from poverty than ignorance

(c) people suffer even in good times

(d) people do not suffer from ignorance

Question number 40: Which one of these statements is correct according to this selection?

(a) poverty implies that outside help is required

(b) more people suffer from pauperism than poverty

(c) pauperism implies that outside help is required

(d) even in good times two million people in Canada suffer from ignorance

Now I will explain the last section of the test:

FOLLOWING DIRECTIONS

The last section of this test contains several questions on following directions. I will read a short selection containing the information you will need to answer a question. You will then mark your answer in the same manner as you have in the first part of the test. Are there any questions?

*Pause for approximately ten seconds to answer any questions.*

Now listen carefully while I read the first direction:

Send your name and address to Gifts, Incorporated, Box 379, Toronto 2, Ontario for your copy of a beautifully illustrated catalog.

Question number 41: What are you to send?

(a) your name

(b) your name and address

(c) your name, address, and 25¢

(d) your address

Here is the next direction:

Read the paragraph at the top of page 172 to find out why Billy wanted to go to the store for his mother. When you think you know the answer to the question close your book and look at me.

Question number 42: Which paragraph are you to read?

(a) the first at the top of page 172

(b) the third at the top of page 252

(c) the second on page 132

(d) the third at the top of page 172

Here is the next direction:

Go six blocks south, turn right and go west until you come to a traffic light; turn left on 46th street and 3617 is about the middle of the block on the left side of the street.

Question number 43: When you come to the traffic light, what are you to do next?

(a) turn left (b) turn right

(c) go west (d) go six blocks south

Question number 44: How far south are you to go?

(a) until you come to a traffic light

(b) to 46th street

(c) six blocks

(d) eight blocks

Here is the next direction:

The teacher said, "Mary, will you please go down to the library and ask Mrs. Smith if we may borrow the *World Almanac* for about 30 minutes? We need it to look up how much coal is produced in Alberta. If she does not wish to let you bring it to the room, ask her if she will help you find the information."

Question number 45: What information did the class need?

(a) how coal is produced in Alberta

(b) what kind of coal is produced in Alberta

(c) where coal is produced

(d) how much coal is produced in Alberta

Here is the next direction:

Miss Brown said, "This morning in our planning period we listed these things that we wanted to complete today: write reports on beef cattle, read about the dairy farm, work on our map of grazing areas, write our spelling test, do the arithmetic problems on page 269, and plan our trip to the farm. It is now 2:00 p.m. and we have just completed our map of grazing areas. What do we do next?"

Question number 46: What do we do next?

(a) work on the arithmetic problems on page 269

(b) write our spelling test

(c) plan the trip to the farm

(d) read about the dairy farm

Here is the next direction:

If you are outside, and you spot a tornado approaching, run to your right (as you face the tornado) as fast as you can. Lie down in the first ditch or gully you can see, and hold on tightly to anything you can grasp. Do not seek shelter behind a building or any other object between you and the tornado--these things could be picked up by the wind and dropped on you.

Question number 47: What is the first thing you are to do?

(a) run inside the nearest building

(b) lie down in a ditch or gully

(c) run to the right (as you face the tornado)

(d) run to the left (as you face the tornado)

For the next directions, you will need the sheet of paper with the numbers in the rectangles.

*Pause for approximately five seconds.*

You may write on the sheet if you want to do so. Look at the rectangles while I read the following directions:

Question number 48: Add the number in the second rectangle to the number in the fourth rectangle and subtract your answer from the number in the third rectangle. The remainder is:

(a) 3 (b) 4

(c) 5 (d) 6

*(On the repetition of this and subsequent questions, only the answers are given)*

Question number 49: Subtract the number in the first rectangle from the number in the third rectangle. Add the remainder to the number in the second rectangle and multiply by the number in the fourth rectangle.

The answer is:

(a) 6 (b) 12

(c) 24 (d) 30

Question number 50: Multiply the number in the fifth rectangle by the number in the second rectangle. Divide the product by the number in the fourth rectangle and add the number in the first rectangle to the quotient. The answer is:

(a) 9 (b) 11

(c) 12 (d) 14

This is the end of the test. Please check to see that your name is on the answer sheet, then turn the answer sheet over and leave it and the sheet with the numbers on your desk.

Remember, it is very important that you do not discuss this exercise with your classmates. When all the work has been completed, your teacher will return your answer sheets and discuss the exercise with you. Thank you for your assistance. Goodbye.

# KEY TO LISTENING TEST

| | | | |
|---|---|---|---|
| 1. | b | 26. | d |
| 2. | c | 27. | d |
| 3. | c | 28. | a |
| 4. | d | 29. | a |
| 5. | b | 30. | c |
| 6. | c | 31. | a |
| 7. | b | 32. | c |
| 8. | b | 33. | d |
| 9. | a | 34. | b |
| 10. | d | 35. | a |
| 11. | d | 36. | b |
| 12. | a | 37. | b |
| 13. | b | 38. | d |
| 14. | d | 39. | c |
| 15. | a | 40. | c |
| 16. | a | 41. | b |
| 17. | c | 42. | d |
| 18. | c | 43. | a |
| 19. | a | 44. | c |
| 20. | d | 45. | d |
| 21. | c | 46. | b |
| 22. | b | 47. | c |
| 23. | d | 48. | a |
| 24. | a | 49. | b |
| 25. | c | 50. | b |

# APPENDIX C

## Details of Modifications Made to the Original Form A of the *Lewis Listening Test*

The introduction to the test was changed from the original to accommodate the fact that the Listening Test was recorded on audio tape. The original set of instructions provided in the *Lewis Listening Test* is given below:

DIRECTIONS FOR ADMINISTERING THE TESTS

The purpose of these tests is to measure how well fourth, fifth, and sixth grade pupils comprehend some of the materials commonly presented orally in the classroom. For the purpose of this test listening comprehension is defined as the assimilation of spoken language when oral and visual clues are both present.

Listening comprehension, like reading comprehension, is made up of many inter-related factors such as the ability to get the main idea from a selection; the ability to recall facts and details; the ability to make inferences from the content of a selection; the ability to recognize word meanings from context; the ability to follow directions; and many others. This test is designed to measure these factors separately to provide the examiner with a tool which will diagnose to some degree the listening abilities of his pupils. Separate scoring is provided for each of the factors listed above. The total score, made up of the subtest scores, provides an over-all picture of the pupil's ability to listen effectively.

While intermediate grade pupils are generally better

listeners than readers, listening comprehension introduces a difficulty not encountered in reading, in that it provides only a single opportunity to comprehend while in reading one may return to the selection if he does not comprehend during a single reading. A test booklet is used with this test because it was found that it was most difficult for pupils to hold four possible answers in mind until they made a choice.

This test is intended for use by the classroom teacher. It should be given in the normal classroom setting. The examiner should study the directions, the test selections and questions carefully before attempting to give the test. Since it is presented orally it is very important that each selection be read at a moderate rate of speed, and in a tone of voice understandable in all parts of the classroom. Oral reading of the selections and questions is recommended prior to administering the test.

The two comparable forms of the test are designed as power tests. No exact time limits have been set. It is expected that the examiner will provide adequate time for marking answers to the questions. The test should be at one sitting and under normal conditions will take approximately 45 minutes to administer, including the time used to pass out materials, fill in the required data on the front of the answer booklet, and collect the booklets when

the test is completed.

SPECIFIC INSTRUCTIONS FOR ADMINISTERING TESTS

Before passing out the answer booklets, check to see that pupils are seated comfortably, where they can see as well as hear the examiner. Check to see that each pupil has at least one good soft lead pencil.

Pass out the answer booklets and separate answer sheets, if they are used, and say:

*You have taken many reading tests to find out how well you can read. This is a test to find out how well you can listen. I will read several selections to you. After each selection is read, I will stop, ask you to open your answer booklet. I will then read the questions as you read them to yourself. You will then mark your answer on the answer booklet. (or separate answer sheet).*

*Now, on the front of your answer booklet (separate answer sheet) PRINT your LAST NAME and your FIRST NAME. Write TODAY'S DATE (give it). Write your GRADE, SEX (boy or girl), and your DATE OF BIRTH, on the second line. Write the name of your TEACHER, and your AGE, on the third line.* (Allow sufficient time for each pupil to fill out the required data.)

Then say:

*Now listen carefully while I read a sample selection.*

[The sample selection read at this point is identical

to the sample selection given in the Transcript of the Listening Test Tape.]

Then say:

*Now open your booklets to page 2.* (If separate answer sheets are used, give these directions in addition: *Now place your answer booklets on top of the answer sheet so that the arrow on the booklet matches the arrow on the answer sheet. The points should meet, and the edge of the booklet should be up against the heavy line all of the way down the sheet.*)

*Look at the first EXAMPLE question at the top of the page.*

[Example question one, identical to the one on the Transcript of the Listening Test Tape, is read here.]

*Since the selection was about how much time we spend in listening, the correct answer is (B). Mark an (X) in the space beside B on the booklet (answer sheet).*

*Now look at the second EXAMPLE question. It says:*

[Example question two, identical to the one on the Transcript of the Listening Test Tape, is read here.]

*When we infer something it means to decide or draw a conclusion from the facts given. Which inference can we make from the facts given in this selection? Wait for the correct answer, then say: Yes, it is important to be a good listener, because we spend so much of our time in the*

*classroom listening. Place an (X) beside answer (A) on the booklet (answer sheet).*

*There will be questions in the test where you will be asked to select the main idea in the selection. Other questions will ask you to make an inference like the one you have just made. In addition, there will be questions about certain details in the selections, and questions about the meanings of certain words as they are used in the selection.*

*Do you understand how to mark your answer? Be sure to mark heavy enough. If you wish to change your answer, you may erase. Be sure to mark only one answer for each question.*

*Your answer booklets are to be closed at all times while selections are being read.*

*Are there any questions about the directions I have given?* Answer questions.

*Can everyone hear me when I read?*

*Now close your booklets and listen carefully while I read the first selection.*

[The first selection is identical to the first selection in the Transcript of the Listening Test Tape. From this point on the directions in the test tape and in the *Lewis Listening Test* are the same except that the latter calls for the closing and opening of answer booklets before

and after each selection.]

In questions 5, 6, 7, 10, 12, 13, 18, 27, 48, 49, and 50, the question alternatives were rearranged. Some of these were rearranged so that numerical answers could be presented in order of increasing magnitude, others were rearranged so that dates could be presented chronologically, and the remainder were rearranged so that there would be an equal number of correct alternatives for each of the four letters used to designate answers.

Questions 11, 41, and 45, and the passages preceding them, were re-written to the extent that Canadian geographical areas and locations were substituted for American ones.

In question 22 and the passage relating to it, the death rate figure was updated from 11 to 8, and the death rate was presented as the Canadian death rate rather than the American death rate.

Question 40 and the passage relating to it were changed to the extent that whereas the original related to 25 million people living in poverty or pauperism in the U. S. A., the modified version related to two million people under those conditions in Canada.

The directions regarding the location of the numbers in rectangles (required for questions 48, 49, and 50) were changed to accomodate the fact that the rectangles were printed on a separate sheet of paper rather than in the test booklet.

# APPENDIX D

## Printed Sheet Used With the Listening Test

# APPENDIX E

## Description of the School and Students

The following description of the school and students is based on information provided by the principal and teachers of the students used in the experiment:

The school plant is approximately 11 years old, and has a student population of 567. There are 11 elementary classrooms and 10 junior-high school classrooms in the school.

The school is located in a district populated by middle- and upper-middle class families. The parents have a cross-section of occupations, with perhaps one-third of the parents engaging in professional careers. The students reflect their parents' interest in socioeconomic advancement by having a strong academic- and career-orientation.

The students are higher than average in intelligence, with an annual *Otis* intelligence test average of about 110. The students engage in numerous activities, especially sports, that are organized by the school and community. The students are generally active and have a good deal of what one teacher called "awareness".

The children are grouped into classrooms heterogeneously, but subdivided into homogeneous groups for some subject areas.

As part of their regular learning activities, the students are assigned to work in small groups, or to individual work in the library.

# APPENDIX F

## Listening Test Scores

| Cell 1 ($a_1b_1$) | Cell 2 ($a_2b_1$) | Cell 3 ($a_1b_2$) | Cell 4 ($a_2b_2$) | Cell 5 ($a_1b_3$) | Cell 6 ($a_2b_3$) |
|---|---|---|---|---|---|
| 22 | 24 | 20 | 23 | 26 | 17 |
| 19 | 27 | 22 | 28 | 18 | 16 |
| 23 | 21 | 30 | 29 | 16 | 20 |
| 25 | 23 | 20 | 24 | 14 | 15 |
| 21 | 18 | 20 | 28 | 23 | 25 |
| 22 | 23 | 17 | 18 | 16 | 24 |
| 22 | 17 | 27 | 28 | 26 | 23 |
| 21 | 22 | 26 | 31 | 24 | 31 |
| 22 | 27 | 20 | 29 | 27 | 21 |
| 37 | 28 | 31 | 32 | 23 | 29 |
| 14 | 14 | 30 | 28 | 24 | 30 |
| 23 | 20 | 29 | 18 | 23 | 25 |
| 25 | 21 | 27 | 16 | 25 | 30 |
| 30 | 26 | 33 | 21 | 27 | 26 |
| 15 | 26 | 33 | 17 | 28 | 39 |
| 22 | 18 | 26 | 21 | 26 | 27 |
| 13 | 19 | 29 | 21 | 30 | 30 |
| 28 | 33 | 25 | 19 | 26 | 26 |
| 31 | 26 | 20 | 22 | 36 | 30 |
| 26 | 23 | 18 | 32 | 35 | 26 |
| 28 | 32 | 30 | 36 | 33 | 27 |
| 23 | 33 | 37 | 27 | 32 | 38 |
| 27 | 21 | 34 | 39 | 21 | 29 |
| 27 | 25 | 33 | 26 | 28 | 27 |
| 566 | 567 | 637 | 613 | 607 | 631 |

# APPENDIX G

## Item Analysis Results

| Item | Difficulty Index | Biserial Correlation | Item | Difficulty Index | Biserial Correlation |
|---|---|---|---|---|---|
| 1 | .434 | .348 | 26 | .262 | .301 |
| 2 | .752 | .264 | 27 | .738 | .222 |
| 3 | .400 | .158 | 28 | .483 | .632 |
| 4 | .310 | .123 | 29 | .331 | .463 |
| 5 | .428 | .162 | 30 | .738 | .288 |
| 6 | .786 | .421 | 31 | .703 | .310 |
| 7 | .572 | .215 | 32 | .600 | .181 |
| 8 | .834 | .351 | 33 | .186 | .321 |
| 9 | .303 | .064 | 34 | .538 | .403 |
| 10 | .572 | .367 | 35 | .352 | .424 |
| 11 | .393 | .268 | 36 | .710 | .285 |
| 12 | .607 | .454 | 37 | .531 | .370 |
| 13 | .766 | .391 | 38 | .152 | .367 |
| 14 | .821 | .436 | 39 | .379 | .213 |
| 15 | .103 | .085 | 40 | .269 | .257 |
| 16 | .469 | .530 | 41 | .717 | .157 |
| 17 | .703 | .400 | 42 | .214 | .254 |
| 18 | .531 | .289 | 43 | .407 | .243 |
| 19 | .393 | .141 | 44 | .531 | .271 |
| 20 | .483 | .246 | 45 | .655 | .300 |
| 21 | .579 | .679 | 46 | .359 | .392 |
| 22 | .793 | .654 | 47 | .766 | .457 |
| 23 | .372 | .429 | 48 | .444 | .182 |
| 24 | .524 | .553 | 49 | .504 | .382 |
| 25 | .317 | .339 | 50 | .486 | .393 |

KR-20 Estimate of Reliability = .684

# Formulae Used in Calculating Item Analysis Data

*Difficulty Index*

$$DIF = \frac{N_r}{N_t - N_f}$$

where $N_r$ is the number of students correctly answering an item,
$N_t$ is the total number of students writing the test
$N_f$ is the number of students not responding because they did not finish the test.

*Biserial Correlation*

$$\text{BISERIAL CORREL} = \frac{M_r - M_w}{S_x^2} \times \frac{P}{Z}$$

where $M_r$ is the mean of the students answering the item correctly,
$M_w$ is the mean of the students answering the item incorrectly,
$S_x^2$ is the total test variance
$P$ is the item difficulty index,
$Z$ is the ordinate in the unit normal distribution corresponding to the proportion p.

*KR-20 Reliability*

$$KR\text{-}20 = 1 - \frac{\Sigma p(1 - p)}{S_x^2}$$

where $p$ is the item difficulty index for each item,
$S_x^2$ is the total test variance.